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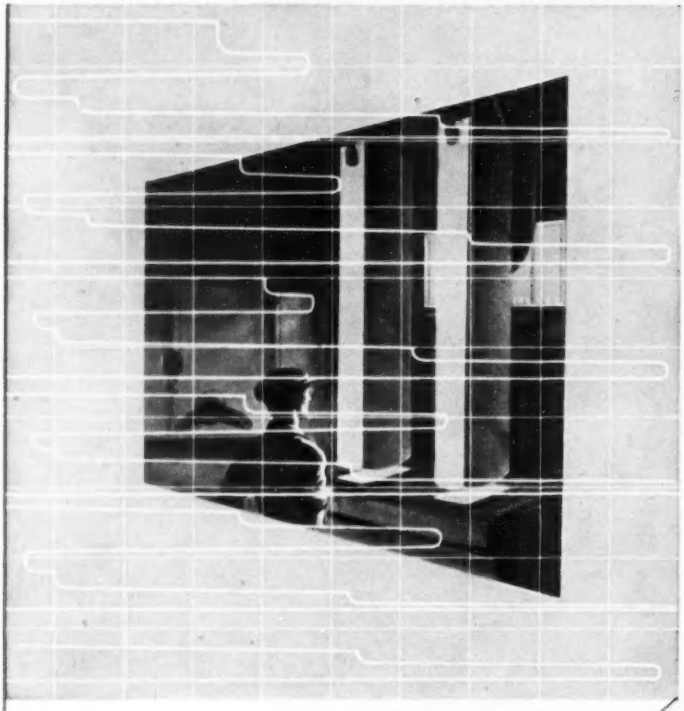

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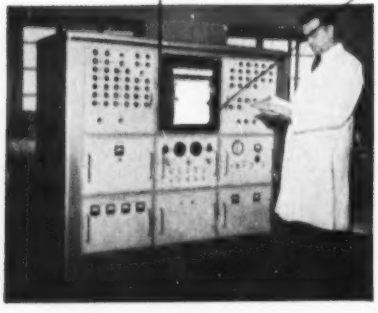

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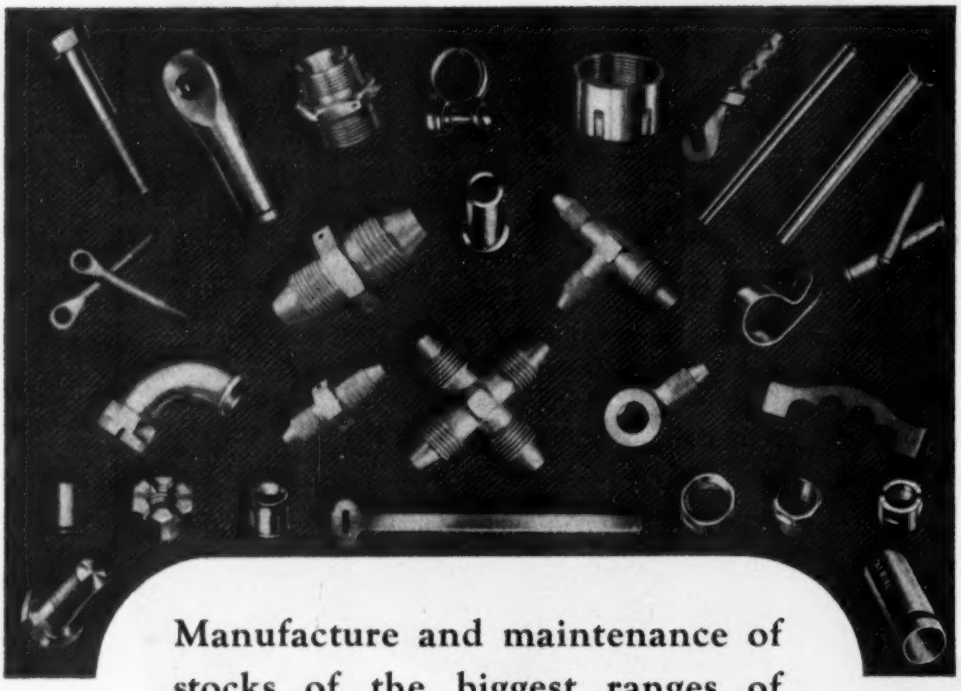

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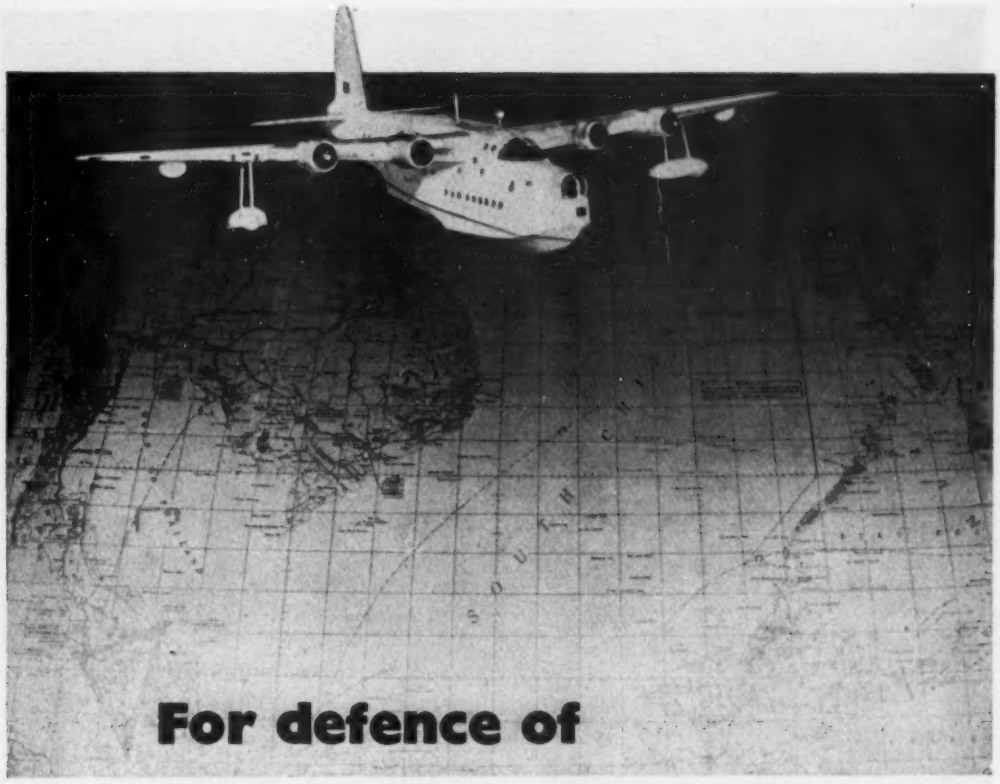

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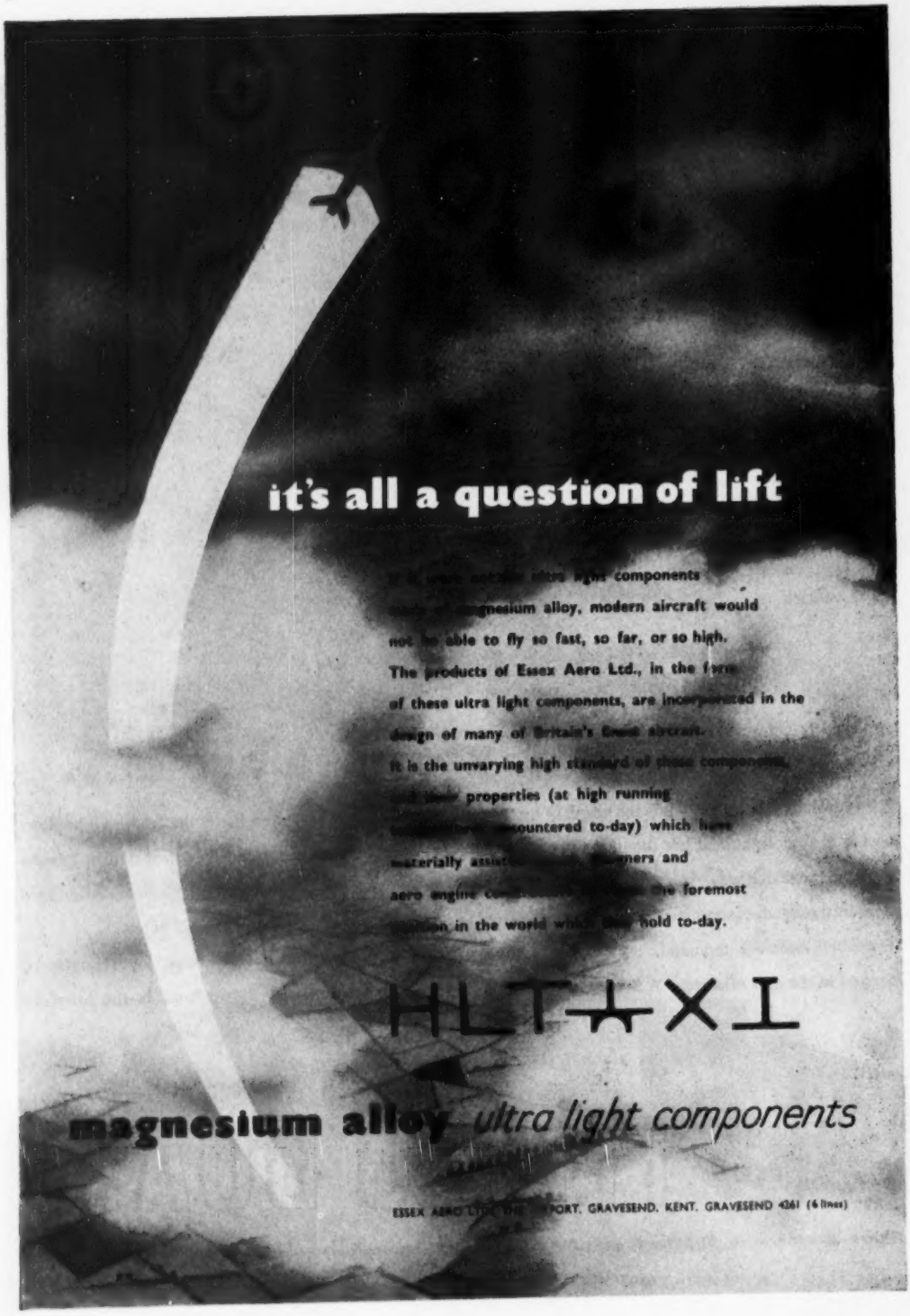
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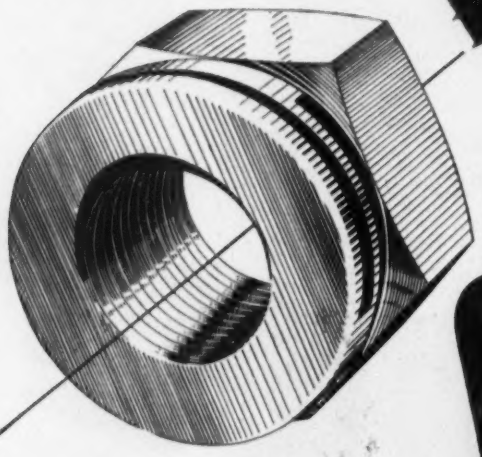

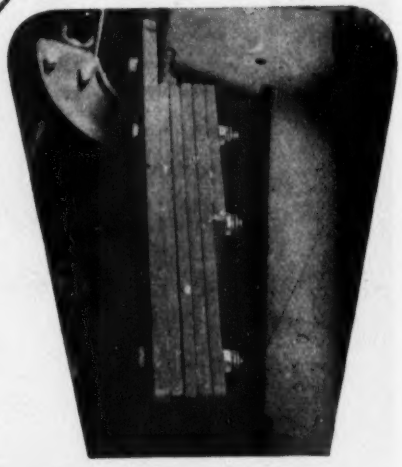

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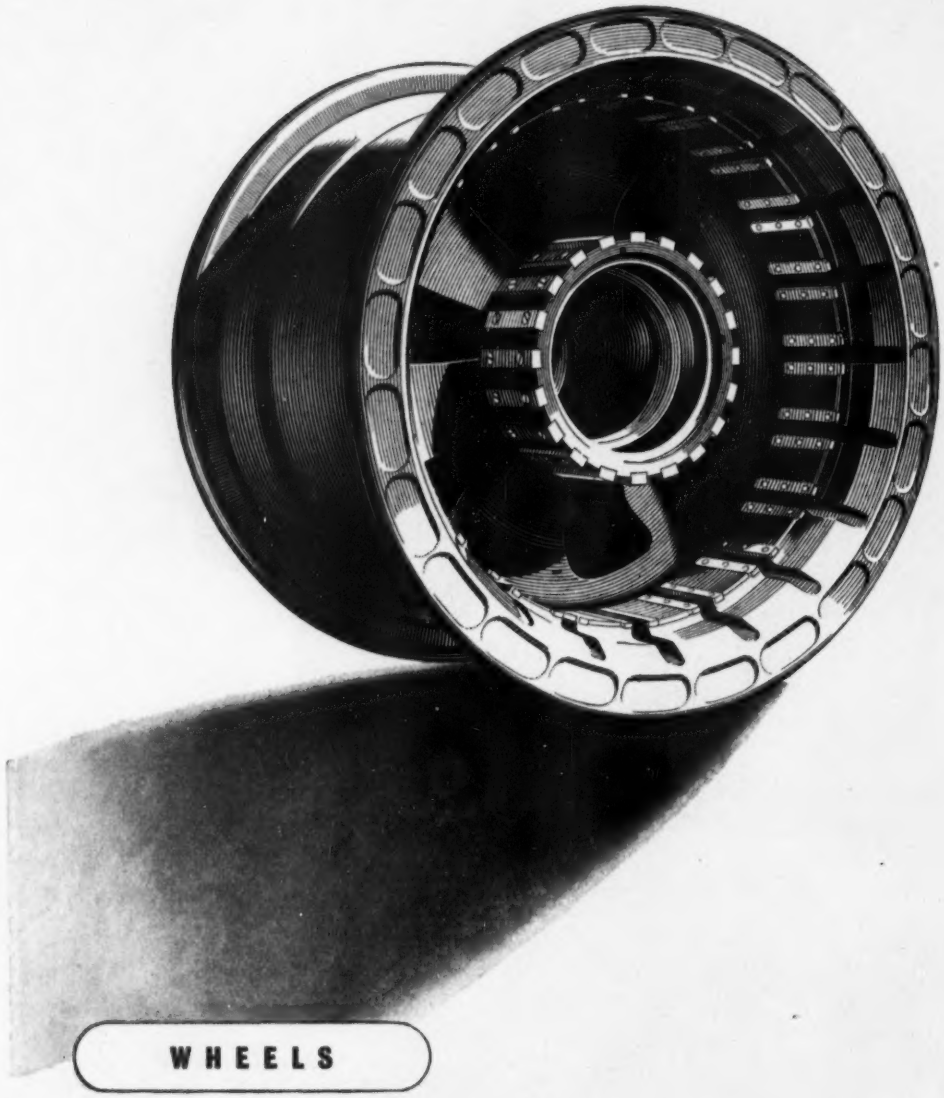

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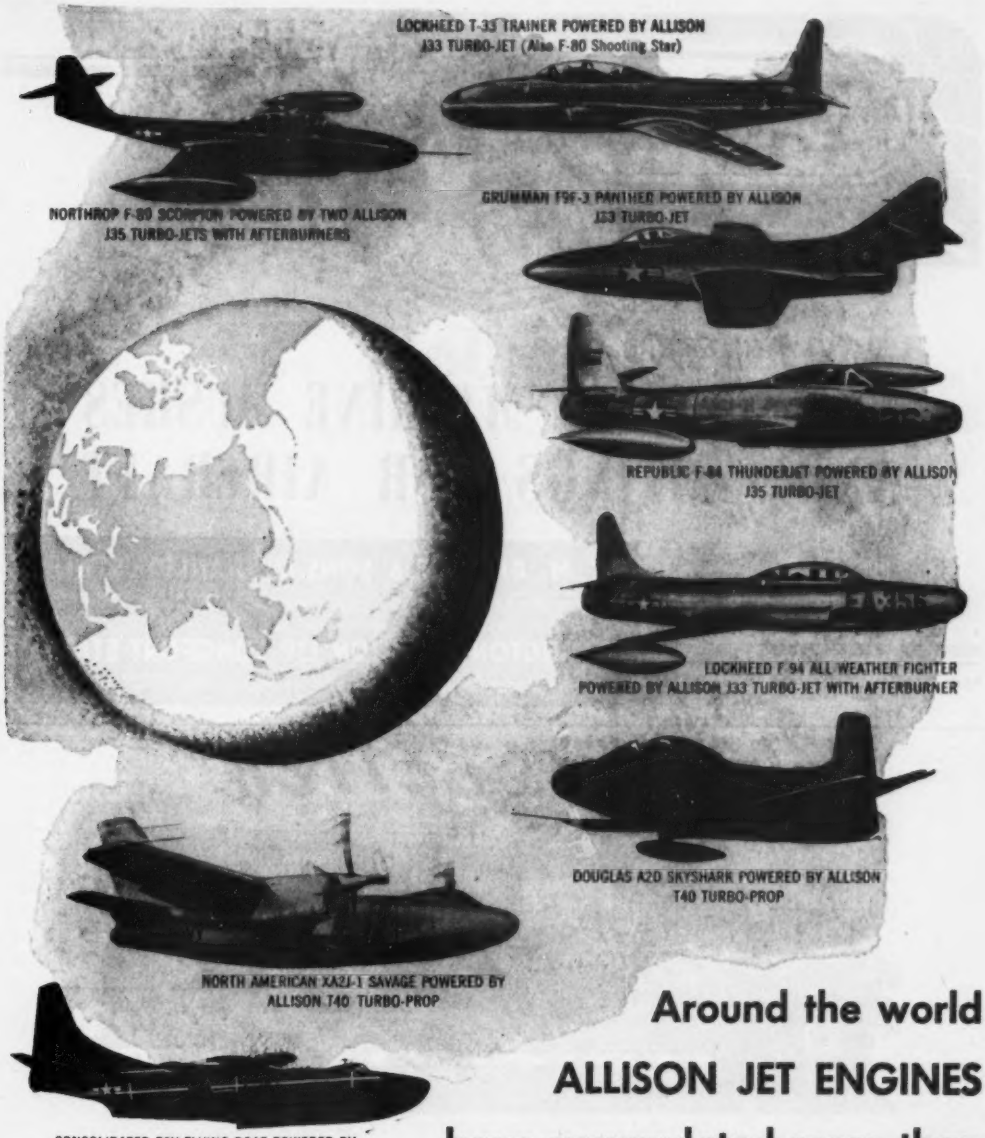
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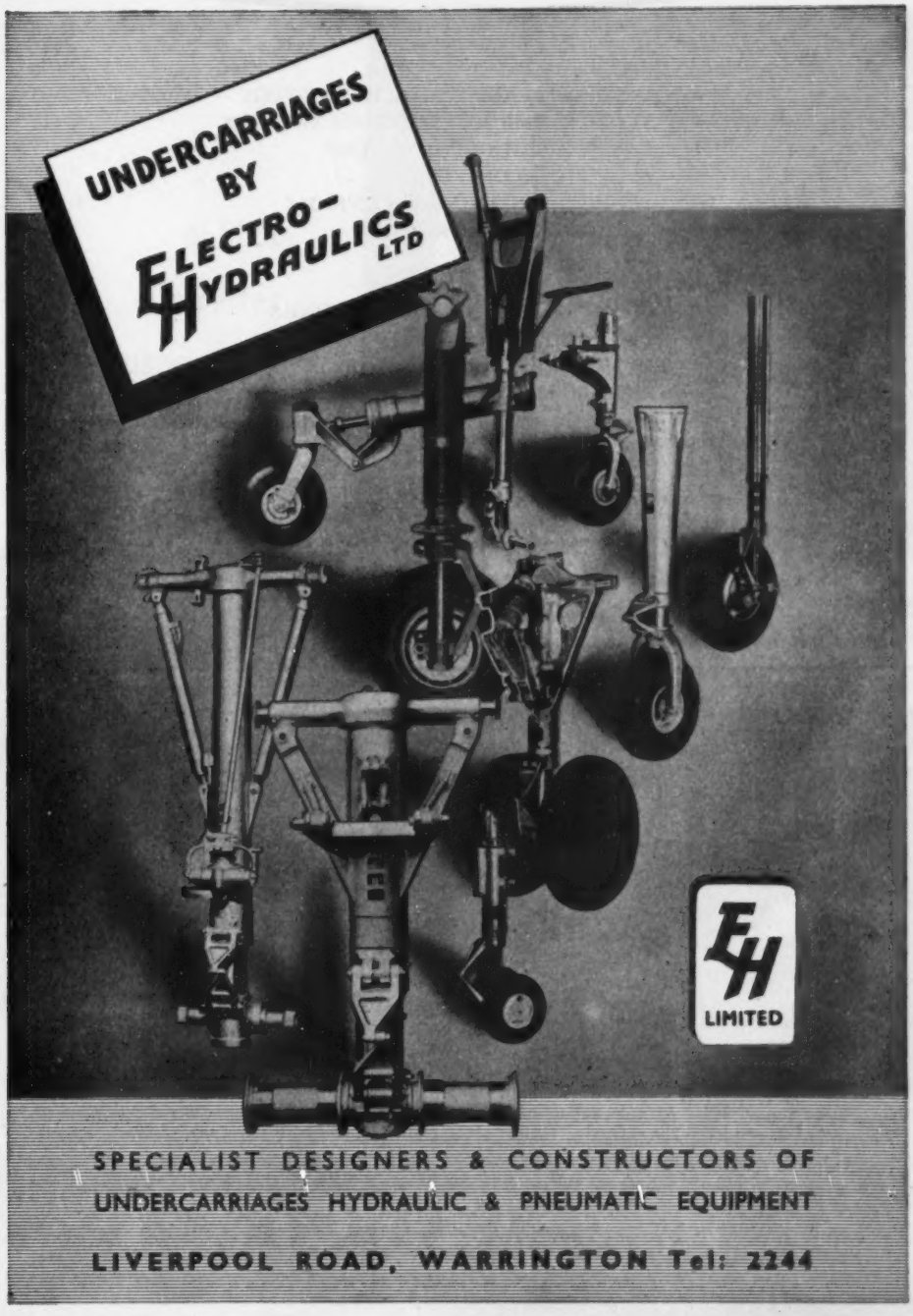
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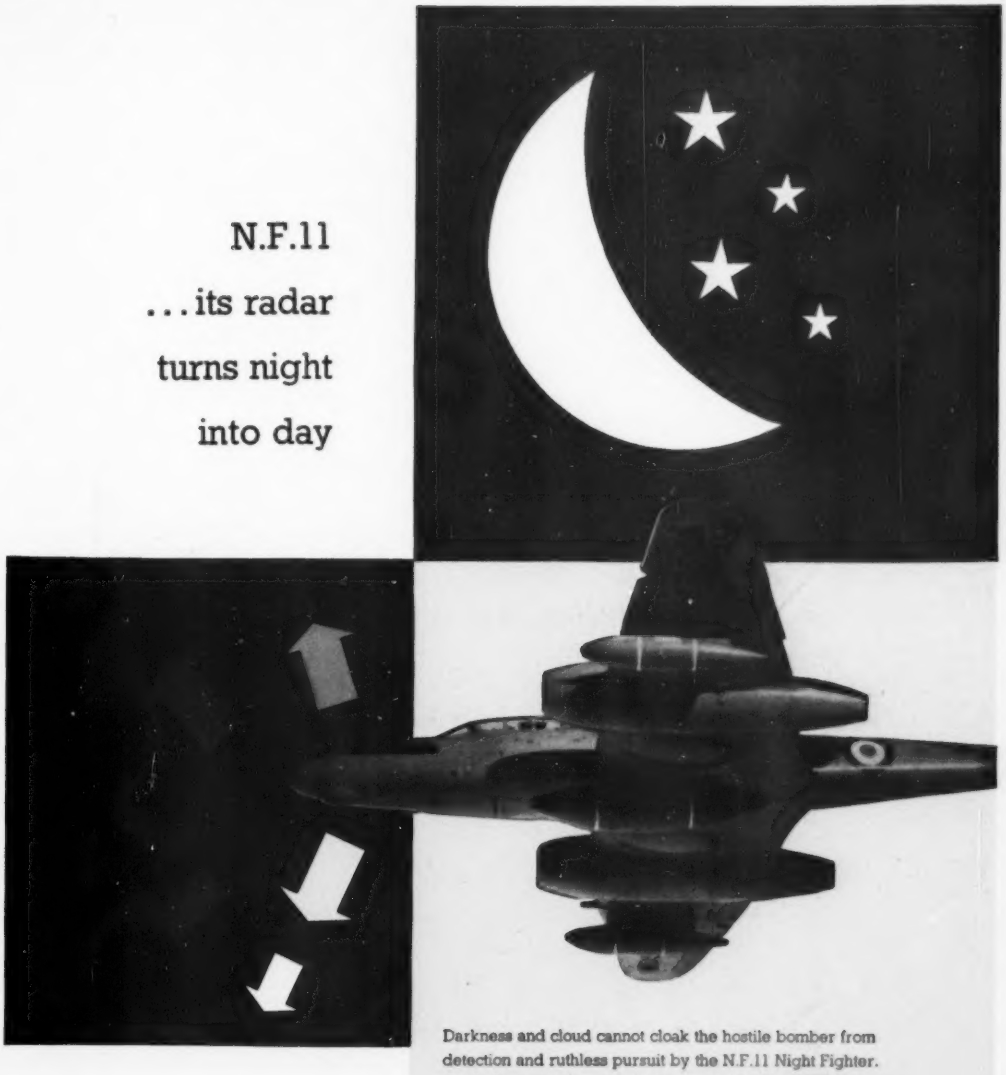

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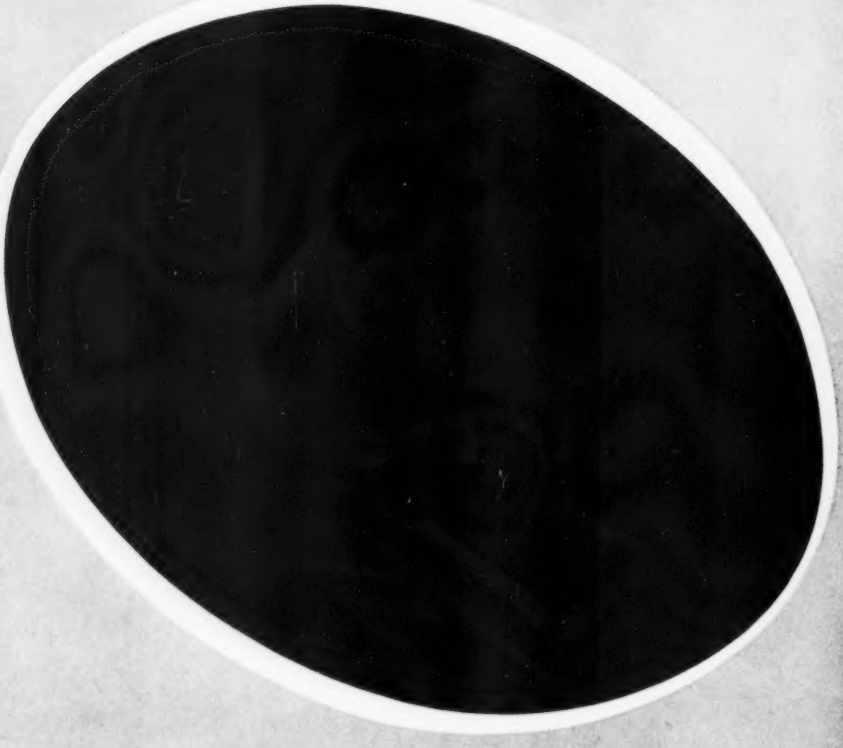

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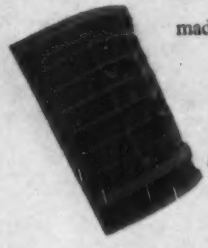

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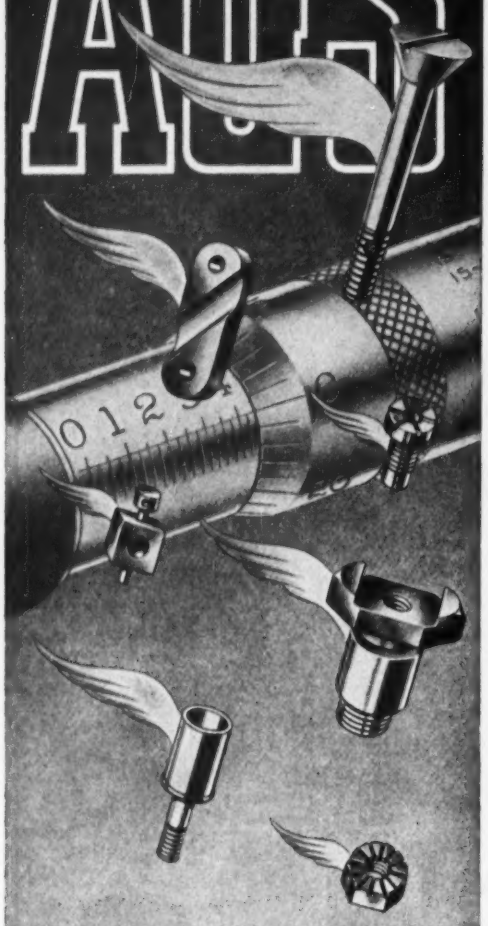

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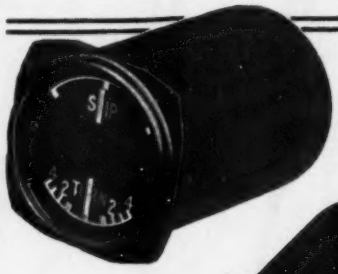

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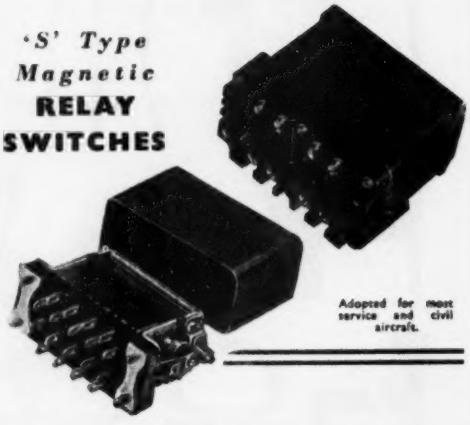

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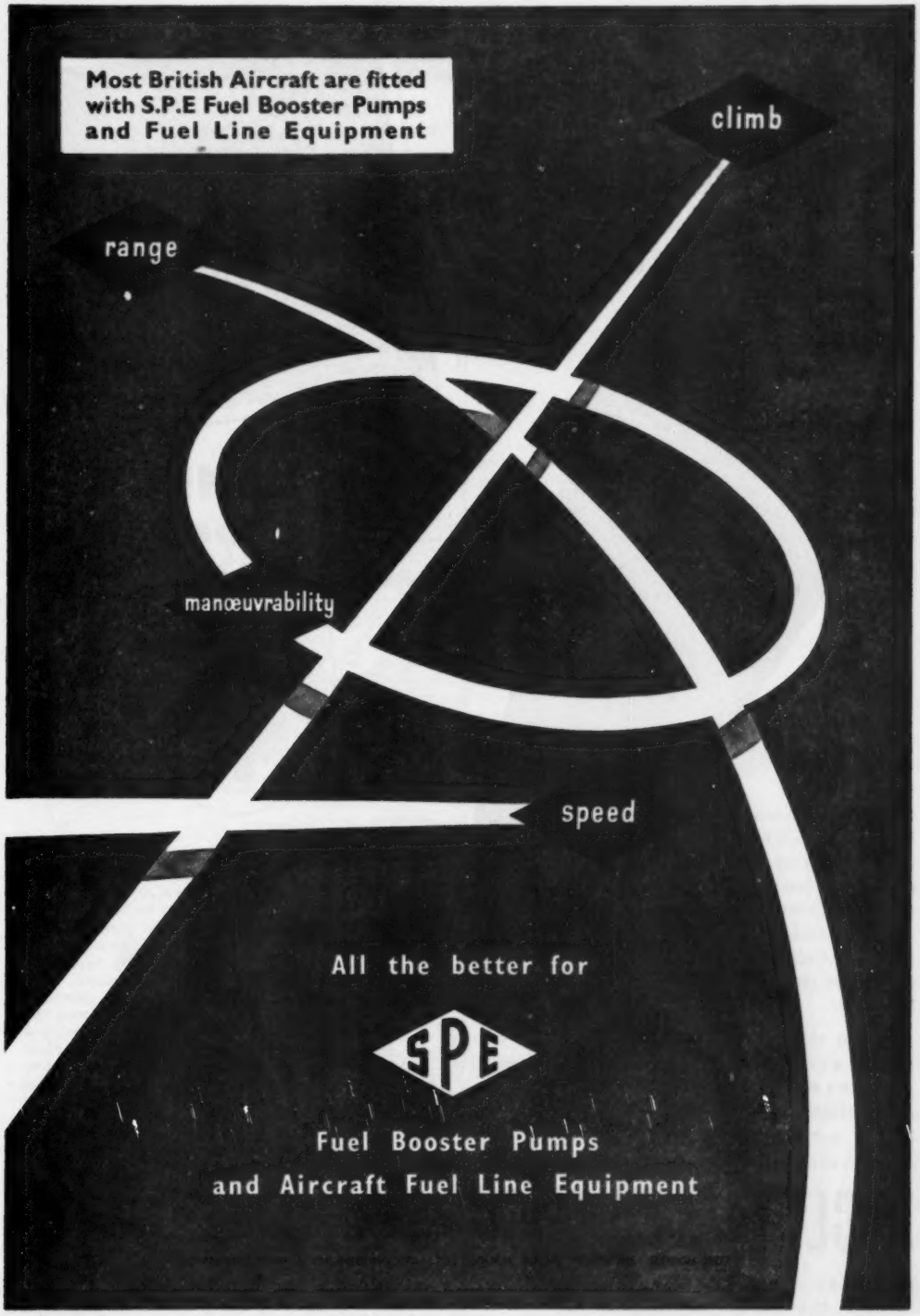
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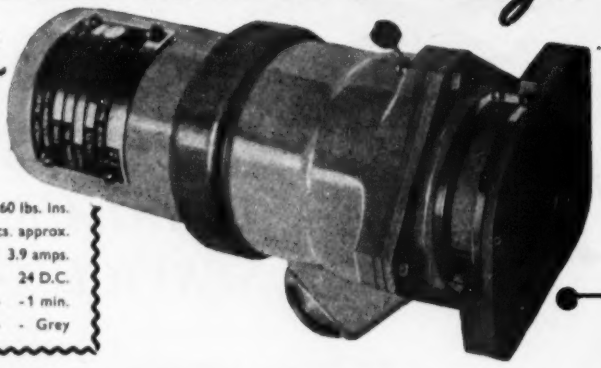
Consumption	3.9 amps.
Voltage	24 D.C.
Rating	1 min.
Finish	Grey



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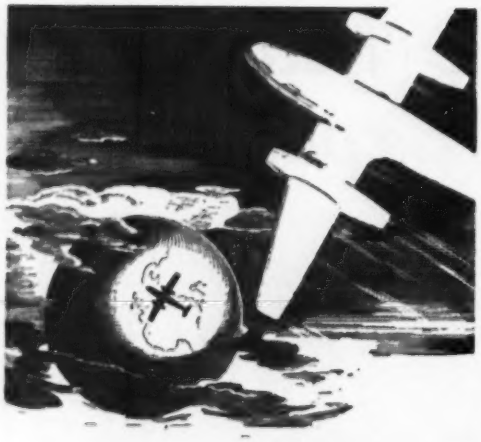

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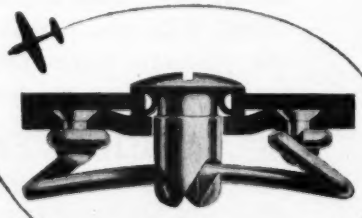

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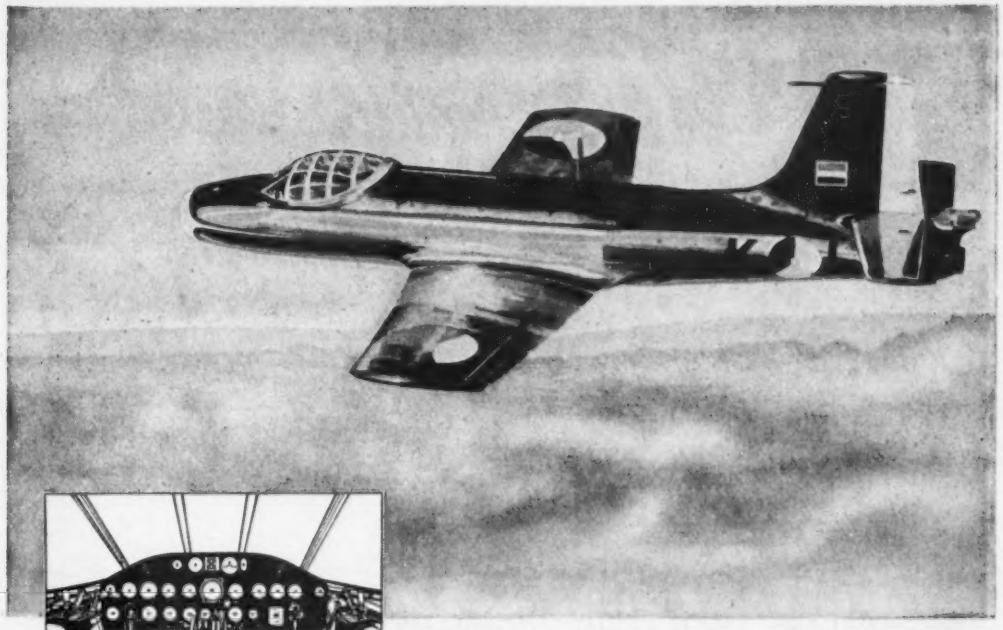

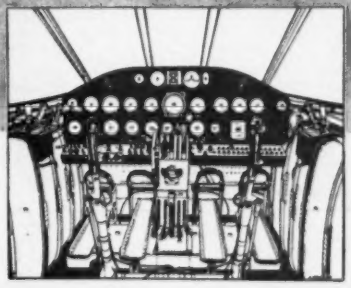

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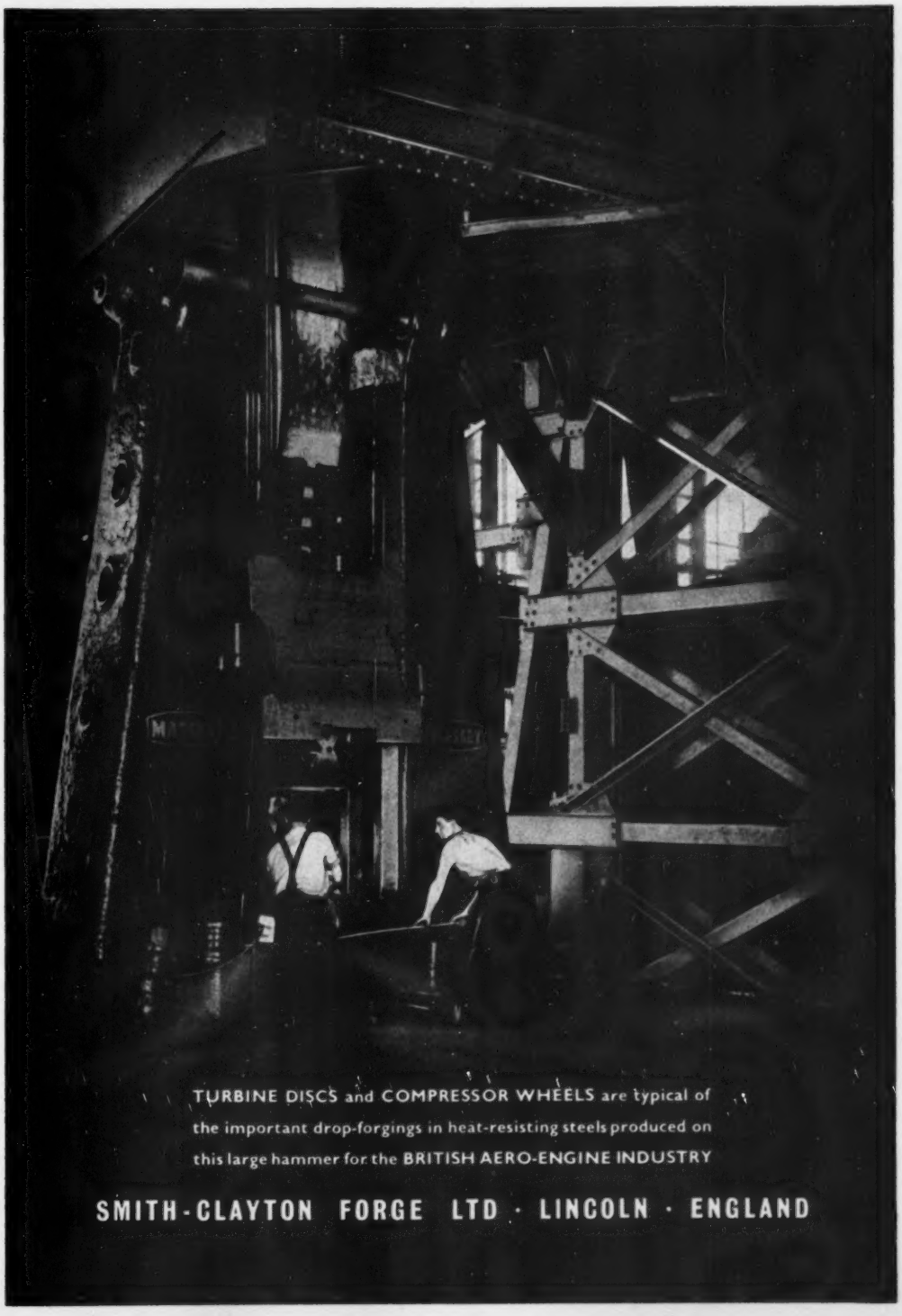
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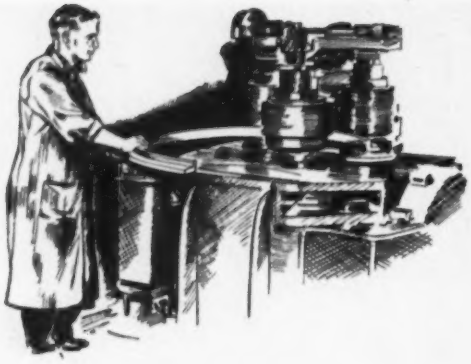

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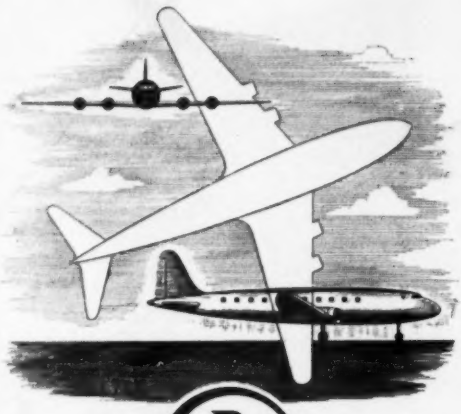

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None so Blind . . . .

ONCE again it is *Flight's* privilege to present a special issue devoted mainly to a review, thorough but concise, of the world's military aircraft. It is more than two years since we last provided such a summary of practices and trends, and since that time we have received gratifying evidence of its value as a source of information and reference. On the other hand, it is also only too obvious that if more people had read and digested the contents of that issue—prepared, as is this one, with the full co-operation of the majority of the aircraft manufacturers at home and in other countries—a less alarming position in regard to the equipment of our front-line squadrons might have existed today.

This seemingly extravagant statement perhaps calls for justification. We may, therefore, quote from the leading article printed in that earlier issue of January 26th, 1950, and intended to highlight matters of the moment. We remarked first that "Very naturally, the reader will seek to draw conclusions regarding British, American and Russian aircraft," and went on to record that "the existence of a new type of Soviet fighter, already in service and of very advanced aerodynamic design, has been confirmed" (a provisional and, as it has proved, reasonably accurate, drawing of the Mig 15 was printed on another page). Continuing, it was stated: "There can be little doubt that if adequate thrust is available, e.g. from a Rolls-Royce Nene, such a machine might match, or even excel, the performance of the F-86 Sabre—and before delivery each Sabre is flown at a speed in excess of 670 m.p.h. . . . it must be admitted that the Soviet Air Force and U.S.A.F. have aircraft potentially capable of operating at Mach numbers approached in this country only by experimental types (Hawker P.1052 and Supermarine 510) for which no production order has yet been announced."

Those words appeared in print over two years ago, yet within the last three weeks the new Under Secretary of State for Air had the unenviable task of telling Parliament: "It is not only in numbers that we are inadequate . . . we are in some respects inferior in the performance of our aircraft. We have today no fighter in service to match the Mig 15, which is already operating in large numbers in Korea, and it will be some time before we begin to re-equip our squadrons with our own latest types." Immediately before this he had said: "There is a foundation for our belief that we now have prototypes of sufficiently high quality and performance eventually to regain for us the lead which we lost temporarily both to the Americans and the Russians. But these new fighters are only prototypes. . . ."

With these facts in mind, it seems all the more remarkable to us that Mr. Arthur Henderson, who was Secretary of State for Air in the late Government, should see fit to comment on Mr. Ward's statement thus: "Both the daily and weekly as well as the foreign newspapers that I have seen have interpreted his statement in terms which indicate the greatest anxiety as to the state of our air defences. I am sure he would agree that it is very much against the national interests that mistaken and misleading impressions of the actual strength and effectiveness of our air defences should gain currency both in our country and abroad." Later, speaking of the Under-Secretary's reference to the inadequacy of the R.A.F. to defend the country or play its part in the defence of Europe, he said: "I should like to ask whether his statement was based on a staff appreciation or a political appreciation . . . in my view the country does not need to be panicked." Either Mr. Henderson has no grasp of the importance of performance in a fighter or sees nothing wrong in R.A.F. pilots being expected to give battle under the severest of handicaps—namely, in aircraft with performance inferior to that of their adversary.

To conclude this leading article of a most important special issue, we have decided that we can do no better than again turn back to that earlier leader and quote: "It is hoped that the present issue of *Flight* will serve not merely as a record and guide, but that it will provide material for meditation at a time when there rests upon everyone some share of the responsibility for safeguarding not only the internal welfare of his nation, but its very existence. At this time, too, we should remember our military obligations to others—obligations which can be met only through strength of arms."

FROM ALL QUARTERS

The Cost of Bigness

INTERESTING figures for the cost of the Brabazon and Princess projects are contained in the report of the Comptroller and Auditor-General on the Civil Appropriation Accounts for 1950-51, published on March 24th.

The original estimate for the Princess flying-boat amounted to £2,800,000, when the three aircraft were first ordered in 1946. By the end of 1947 the figure was revised to £4,500,000; this was considered excessive by both the M.C.A. and B.O.A.C., who agreed to abandon further work. A study by British South American Airways showed that, provided eight Princess aircraft could be obtained "at an economic price," that Corporation would be prepared to operate them; development then continued, although B.S.A.A. later was merged into B.O.A.C.

By June, 1950, the M.o.S. estimated the total Princess bill to reach £10,800,000—£8,000,000 up on the first estimate—and it has probably grown further since that date. In March, 1951, it was reported that the three boats would be completed for R.A.F. Transport Command; finally, last December the Air Ministry withdrew its earlier request for the aircraft, and work on the second and third machines has stopped.

The first Brabazon estimate was placed—no doubt generously—at £8,000,000 in 1944. An eventual demand for 12 Mk I aircraft was foreseen, but by 1950 it had been decided that no order should be placed, but that the Mk 2 aircraft should be completed to provide additional research data. By March 31st, 1951, the two prototypes had cost £4,157,506 exclusive of engines, while the runway and "Brabazon building" at Filton had accounted for a further £6,000,000—nearly double the estimate. The present Brabazon estimate stands at £14,000,000.

Sampling the Avon-Comet

ON March 27th, Sir Miles Thomas and Sir Geoffrey de Havilland shared the experience of a 60-minute flight in the Avon-Comet, piloted by John Cunningham. Also aboard the Comet, which flew from Hatfield in a hailstorm, was Sir Francis Brake, a member of the B.O.A.C. board. During the flight, John Cunningham had hoped to test de-icing equipment in humid cloud, but found only brilliant sunshine.

Asked if he had noted any difference between the Ghost- and Avon-powered Comets, Sir Miles Thomas said that both were remarkably free from vibration; the Series II Comet had, if anything, a new note ("the Comet I goes with a 'swish' while the Comet II goes with a 'swoosh' "). He was very much impressed with the acceleration and rate of climb of the Avon-Comet, its smoothness and its steadiness. Unofficial figures of 3,500ft/min and 525 m.p.h. have already been quoted for, respectively, the aircraft's rate-of-climb and cruising speed.

The Debate Continues

THE warnings on the state of Britain's air defences which had formed an important part of the opening speech by Mr. George Ward, Under-Secretary for Air, during the Air Estimates debate (reported in *Flight* last week), were severely criticised in the Commons last week, when the Estimates were again considered on the Report stage.

Mr. Arthur Henderson, the former Under-Secretary for Air, said that anxiety had undoubtedly been created by the speech. He thought it very much against the national interest that mistaken and misleading impressions of the actual strength and effectiveness of the air defences should be given currency both in this country and abroad. He was sure Mr. Ward would agree that the R.A.F. was both a substantial and efficient force. By the end of this year, he said, our fighter strength would at least be equal to the fighter strength of the R.A.F. at the time of the Battle of Britain. Mr. Henderson then drew attention to the statement by Marshal of the Royal Air Force Sir John Slessor on March 2nd that the R.A.F. contribution towards European air defence was even more than that of the United States.

In his view it was dangerously misleading to look at the size of the R.A.F., for if another war came it would be joined by the U.S. air forces. Surely one must look at the combined defence system and include both the R.A.F. and U.S. Air Forces, and not argue that, if you took them separately our defences were woefully inadequate? Mr. Henderson wondered if Mr. Ward's statement had been based on a Staff appreciation or a po itical appreciation. In view of Sir John Slessor's statement he could hardly believe it was an Air Staff appreciation.

Replying, Mr. Ward maintained that Britain must accept the primary responsibility of defending these shores. Referring to deficiencies in our present air strength, he said the fact remained that if enemy bombers came over in large numbers escorted by large numbers of fighters it was no earthly good pretending that a straight-wing jet fighter would be a match for a swept or delta-wing fighter.

At this point Mr. Frank Beswick asked Mr. Ward to agree that if an enemy force came to these shores it would be attacking not just one country but an Anglo-American base. Would it not be reasonable to expect that with our fighters would also be American fighters?

Mr. Ward replied that Mr. Beswick seemed to think it was perfectly right for us to hang on to obsolescent fighters so long as the Americans had their Sabres. He believed we should have the latest types of fighter. His aim was to see by all possible means that our pilots went into action, if that proved necessary, on equal terms with their opponents, and if possible on superior terms.

"Flight" photograph

HONOURED: At the annual general meeting of the Royal Aero Club last week, the Britannia Trophy (seen in the foreground) was presented to Capt. O. P. Jones of B.O.A.C. (left), while A. Cdre. Sir Frank Whittle (right) received the Gold Medal of the F.A.I. In the centre is Lord Brabazon of Tara, who made the presentations. The Britannia Trophy is awarded annually "for the most meritorious performance in the air by a British aviator" and Sir Frank Whittle's award was in recognition of his work on jet engines.

America's Transport Reserve

IT is learned from Washington that America is to begin immediately to modify 331 four-engined civilian aircraft so that they shall be ready for military use at 48 hours' notice. This is part of the U.S. Government's step-by-step plans announced on March 26th for commandeering up to 400 civilian aircraft in the event of "all-out war." Full mobilization would thus leave only 184 four-engined machines for regular civil services in America and these would be allocated to airlines by the Civil Aeronautics Board. According to Maj.-Gen. Joseph Smith, Commander of the Military Air Transport Service, changes in the 331 machines would cost not more than 10,000,000 dollars (£3,567,000 sterling) which the U.S.A.F. would pay. Modifications would be completed in about a year. Civilian airlines would operate the machines after mobilization under contracts with the armed forces. Among the 331 machines to be modified, 91 would be earmarked for first-line reserves to be taken over immediately in any emergency; a second-line reserve of 240 would be ready for military use as needed. Types concerned are Douglas DC-4 and DC-6, Lockheed Constellation, and Boeing Stratocruiser.

Napiers Acquire British Salmson Factory

FROM D. Napier and Son, Ltd., of Acton (a subsidiary of the English Electric Co., Ltd.), comes the announcement that they have purchased the factory and equipment of British Salmson Aero Engines, Ltd., at Raynes Park, London, S.W.20. This, they state, "arises from the need to expand manufacturing facilities for the development of new types of aero and marine engines."

Among current commitments of the Napier company, apart from development of their compound Nomad, is the production of Rolls-Royce Avons. At last week's annual general meeting of

the English Electric Co., the chairman, Sir George H. Nelson, said that for the latter purpose a new factory was being built.

At the Raynes Park works—a compact plant of modern design—British Salmson, in pre-war days, manufactured the French Salmson radial engines under licence. Since then they have been engaged on sub-contract work for a number of leading airframe and engine manufacturers. The Napier announcement states that British Salmson "have made arrangements for the continuance of certain special activities formerly carried out at the Raynes Park works."

Winged Targets

THE problems of designing and towing a winged target for live-ammunition attacks by fighters and A.A. guns are by no means as simple as might be supposed, but details lately released by the R.F.D. Co., Ltd., indicate that in their Mk 1 target these problems have largely been overcome.

Soon after the war, the company sent examples of their 16ft winged targets to the Aktiebolaget Flygmal of Sweden, an associate firm, and from these AB Flygmal developed the 30ft type. The British Naval Attaché in Sweden, where the Aktiebolaget Flygtjanst fly them for the Swedish Government, saw this target and reported upon it to the British Admiralty, who asked R.F.D. Co. to give a demonstration in England. This was given in September, 1950, and was followed by a contract for ten for trials at Boscombe Down for the Royal Navy.

The R.F.D. Flygmal version was modified in England to 26ft span and was strengthened. During trials at Boscombe Down, this target (now known as the Mk 1) has achieved 240 kt I.A.S. at 24,000ft behind a Hornet. This represents 355 kt T.A.S., or 409 m.p.h. The target has also been flown behind Tempest, Sturgeon, and Meteor aircraft.

This twin-fuselage wooden target, of conventional form is extremely sturdy and is now being made radar-responsive. A photograph of the Mk 1 target appears on page 418.

First in the Queue

THE distinction of being the world's first passenger to book a passage in a pure-jet airliner goes to Mr. A. Henshaw, of Mablethorpe, Lincs, father of Alex Henshaw, who was so well known as a racing and records pilot in pre-war days.

Now in Australia on a world tour, Mr. Henshaw, senr., applied in January of last year for a booking on the first B.O.A.C. Comet service "whenever and wherever it may be." He will now have to hasten home from Australia in order to take up his option—on the inaugural Comet flight to Johannesburg on May 2nd.

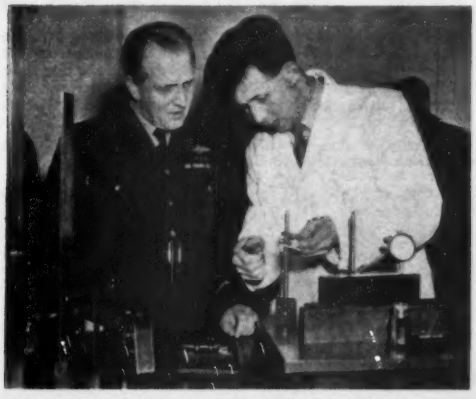
F/L. T. B. O. Evans

IT is with great regret that *Flight* has to record the death of F/L. T. B. O. Evans, D.F.C., a test pilot of the English Electric Co., Ltd. He was the only occupant of a Canberra which crashed on March 25th, shortly after taking off from the company's airfield at Samlesbury, Lancs.

F/L. Evans was an experienced fighter pilot, having served in the Far East, and elsewhere, during the war. From 1944 until he joined English Electric in 1950 he was employed on the development of R.A.F. jet aircraft, notably the Vampire. During a distinguished career with Fighter Command he was the No. 2 pilot of the Fighter Demonstration Unit. He leaves a wife and three children.

Later last week—on the afternoon of March 27th—a Canberra of R.A.F. Bomber Command was lost, with its crew of three, near Beelsby, Lincolnshire. The aircraft, which belonged to the second R.A.F. Canberra squadron to be formed was making a short training flight from Binbrook. A violent snowstorm was reported to be raging at the time.

This latter Canberra is the first to have been lost in R.A.F. service; apart from the one destroyed earlier last week, two others have crashed, one at Bulwell, Notts, last June and the other near Baltimore, U.S.A., last December.



GOOD WORK: A. Cdre. H. J. G. E. Proud, C.B.E., A.O.C. Northern Ireland, addressed the apprentices of Short Brothers and Harland, Ltd., at the recent annual prize-giving, when over 80 young men received awards. The prizes were presented by Lady Herbert, the wife of Sir Edward D. A. Herbert, O.B.E., chairman of the company. In this photograph A. Cdre. Proud is seen watching an apprentice at work.

An Airwork Appointment

Sir Archibald P. Hope, Bt., O.B.E., D.F.C., who has been commercial manager of Airwork, Ltd., since 1950, and has now been appointed managing director. Mr. M. D. N. Wyatt will retain his chairmanship and, it is stated, will continue to take a close interest in the company's business affairs.

Newcastle "Nationals"

DETAILS have been issued by the Royal Aero Club of the five National Air Races to be held at Newcastle-upon-Tyne Airport on July 11th-12th. Four of the events will be flown separately after 6 p.m. on Friday, July 11th, over two laps of a four-sided course. The races, all international handicaps open to any type of aircraft within the stated take-off-weight categories (shown in brackets), are as follows: Grosvenor Challenge Cup (not exceeding 1,653 lb); Norton-Griffiths Challenge Trophy (1,653-2,205 lb); Kemsley Challenge Trophy (2,205-3,858 lb); Air League Challenge Cup (over 3,858 lb).

The course is Newcastle Airport—St. Mary's Lighthouse—North Seaton Links—Stannington Airfield—Newcastle Airport. The distance is 32.6 miles, making a total distance of 65.2 miles for each of the races named above; in each case prizes will be £100, £50 and £25 for first, second and third places—in addition, of course, to the trophies.

The fifth race, for the King's Cup, is confined to British entries. It will be held at Newcastle on the afternoon of Saturday, July 12th. Competitors for the King's Cup will be drawn from finishers in the four events flown the previous evening; those qualifying will be the first three British entries in each, plus the three fastest British finishers (additional to the first three). Thus the total maximum entry will be 24. Distance of the race will be 130.4 miles—four laps of the quadrilateral course given above.

The winner of the King's Cup Air Race will receive the cup and £100, and cash prizes for second and third places will be £50 and £25. In addition, prizes of £100, £50 and £25 will be awarded to the entrants of aircraft which achieve first, second and third fastest speeds in the King's Cup race in each of the four weight-categories listed above. Prize money at the Newcastle meeting will thus total £1,575.

Though complete races in their own right, the four events scheduled for July 11th will, in effect, also serve as heats for the premier event in the air-racing calendar. With less than 24 hours in which to complete their calculations for the King's Cup, the handicappers can expect to work overtime on the night of July 11th.

All entries, accompanied by the £10 entry fee for each of the four international races (competitors qualifying for the King's Cup will not be charged an additional fee), must reach the Royal Aero Club, 119, Piccadilly, London, W.1., not later than May 19th.

As described in *Flight* last week, the Royal Aero Club has also recently announced its plan to stimulate competition by instituting the British Air Racing Championship. At the end of the racing season, the winning pilot will receive the Club's Jubilee Trophy and £100, and will be declared British Air Racing Champion. Runners-up will receive £50 and £25. The awards will be made on the basis of points scored in nominated events.

"FLIGHT" PHOTOGRAPHS

Although the shape and layout of the aircraft are distinctly unusual, the appearance is not unpleasing.

AMBULANCE/FREIGHTER In the Air

First-hand Experience of Austers' Unique Light Aircraft

No. 46 OF THIS SERIES

By THE EDITOR

JUST because an aircraft is bulky and even angular, it need not feel cumbersome in the air. This contention is borne out by most freighters and, among them, the unique little Auster Ambulance/Freighter, which has now reached an advanced stage in development.

Recently I was given an opportunity to fly the prototype at Rearsby, the makers' home field, and can testify without hesitation to its friendly, docile disposition and ready response to controls. The aircraft is about to undergo a complete work-out at Boscombe Down, although as yet no firm Service order has been placed for it. Such have been the inquiries, however, that the makers have decided, circumstances permitting, to build an initial production batch.

Undoubtedly the requirement exists, and unofficially the Army are known not only to have been impressed with the demonstration flights arranged for them during manœuvres, but to have expressed a desire to have some. Thus the future of the aircraft, originally known as the Model B.4, seems very promising.

It is relevant to mention that to some extent the components of a production Ambulance/Freighter can be made interchangeable with the production version of the A.O.P. Model S prototype, which, it is learned, will embody a number of improvements and be known as the B.5.

Both these aircraft are to be powered with the 180 h.p. Cirrus Bombardier 702. Following experience with v.p. airscrews, the advantage has been found to be so small as not to justify their use; accordingly, fixed-pitch metal airscrews are now to be fitted.

It may be added that the possibility of fitting the American Continental E.190 flat-six engine in the A/F. is more than a mere suggestion. American-type instruments and equipment could also be installed.

Before describing the handling qualities of the A/F., it may be as well to jog memories with a few general constructional and other details. For example, the method of construction, if not the appearance, follows Auster tradition, being almost entirely of fabric-covered metal. The exceptions are the wooden wing spars and hinged tail fairing to the cabin or hold. It is possible that wing construction may be altered in production aircraft.

According to duty, the aircraft can carry four seats or two seats and two stretchers (loaded from the rear), one above the other; in each case this is in addition to fuel, radio and normal night- and day-flying equipment. For freighting, the floor can be cleared except for the pilot's seat, the other seats being quickly detachable. I timed two ground engineers to do the conversion in 4 min 20 sec.

A recent modification is the fitting of a steerable port tailwheel and Liquid Springing for both the rear wheels. The starboard wheel is of the free-castering type. Regarding weight distribution, although there is a slightly greater percentage of weight to be borne by the rear wheels, because there are two of them, the load on each is much less than with a tail-down tricycle layout.

As we commented in October of last year, the interior is khaki in colour, and the controls, switches and levers are very simply arranged. Being intended primarily for light transportation in the Army, the aircraft is, appropriately enough, rather reminiscent of a jeep inside. It is no

It is said that every picture tells a story: this landing shot certainly gives a true impression of the impending firm, but soft-sprung, landing which the Ambulance/Freighter will make. The sturdy undercarriage and large-section tyres are well-suited to the aircraft's duties.

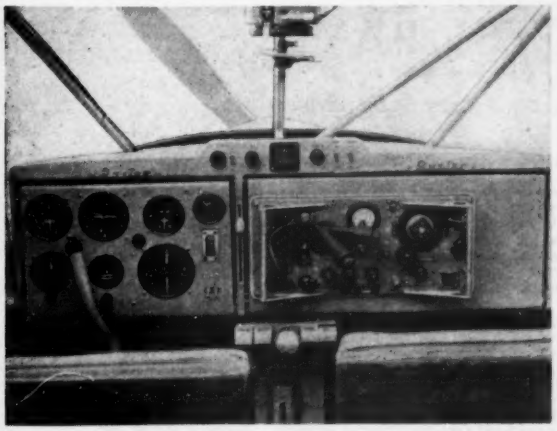
contradiction in terms to sum up the A/F. as a rugged light aircraft.

It is said that a Boscombe pilot once wrote of a military twin he had just tested: "This aircraft is very difficult to get into—it should be made impossible." In contrast, the Auster has a good-sized door each side (as well as the tail hatch) and is relatively easy to enter; moreover, I would recommend that anyone who has the chance to fly it should do so for the experience is a pleasant one.

The Bombardier (which is, of course, equipped for direct fuel-injection) started-up readily when I pulled hard enough on the wire to operate the Plessey cartridge-starter. It idled quite smoothly and without any sign of the awful shuddering which is sometimes associated with big four-in-line engines ticking-over in small aircraft. The American-style push-pull throttle is smooth in operation and gives the right sensitivity of control. This throttle is centrally mounted and situated between two pairs of un-aircraft-like controls which look after (port to starboard) cabin heat, parking brake, and fuel and oil temperatures (see photograph).

I went through the routine checks with particular care because the aircraft was new to me and I had not flown for several weeks, and then set about some prolonged taxying to test the new steerable tailwheel and springing, and to see how a fat machine with rudder and fin above the slipstream might control.

The answer was that it steers and controls very well, and is pleasantly soft-sprung. For sharp turns and close parking



The complication of the temporary Army-type radio is in marked contrast to the simple flying panel and control arrangement.

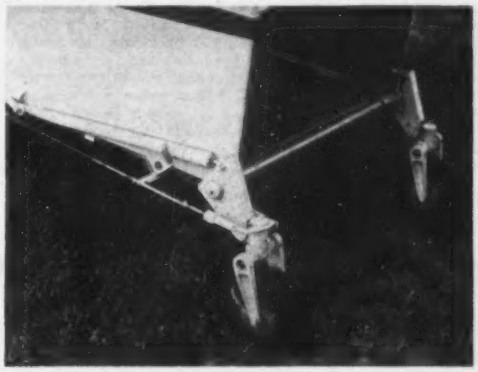
the heel-brakes are required, but for all normal movement about field or runway the rudder alone suffices. The brakes —of Goodyear disc type—are much better than on most Austers I have flown and, as I discovered later, may be used quite strongly on the landing run.

And so to the take-off—using a little flap and, to start with, carefully lined-up into wind. As I opened up I obeyed the instruction given earlier by Ranald Porteous and kept the two tail wheels on the ground until speed built up; then, as the tail came up a little, the rudder gave sufficient directional control. For the early part of the short run there is a tendency to swing, which has to be countered by fairly coarse use of the rudder-operated steering. However, it should not be supposed that the procedure calls for any special skill or experience.

The Auster flap-lever and catch—operated with the left hand over the shoulder—has always worried me, and although I am assured that carefree operation is only a matter of knack—readily acquired by everyone, including anæmic dwarfs or the frailest of W.R.A.C.s—I remain unconvinced. Perhaps I must resign myself to being the exception in the case of this small physical exertion, like Betty Macdonald in *The Egg and I*—who, though most anxious to be co-operative, is "unable to wink."

Once airborne—and the A/F. flies off readily at about 50 m.p.h.—the climbing angle is steep and, in spite of the austere military furnishing, the engine noise is by no means excessive. Spotters will note the new exhaust stack. Flying solo with tail-cone on, the rate of climb is rapid—probably as much as 1,000 ft/min initially. With passengers and tail-cone off (it is quickly detachable to accommodate long objects—tent poles or other Army what-have-yous), the performance is noticeably reduced, but is nevertheless adequate for the job. Best climbing speed is 70 m.p.h.

Weather, time and the type of aircraft forbade my doing anything fancy with the A/F., but I confirmed that the controls are well harmonized and somewhat lighter than



The port-side steerable tailwheel and its Liquid Spring. The starboard wheel is of the free castering type.

might be expected. The aircraft is easily trimmed to fly hands-off and is stable about all axes. The trim lever is mounted centrally between blind-flying panel and Army radio. It is convenient in this position, but the movement is on the long side and the control itself a little more sensitive than I would choose. The lazy pilot will find that the A/F. will turn and fly on stick alone with little slip or skid, and bank conveniently follows the application of rudder alone.

I had forgotten to ask if spinning was yet permitted, so contented myself with stalls of various kinds. There was no tendency to drop a wing, and recovery was immediate from the gentle sink of the nose. Full flap increased the extent of sink and nose-drop, as would be expected, but that was all. There is no particular warning of the stall, but a man would be a Prune to pull the stick so far back or get the

AUSTER AMBULANCE/FREIGHTER

(180 h.p. Cirrus Bombardier 703)

Dimensions and Weights

Length	24ft 8in
Span	37ft
Wing area	189.75 sq ft
Loading door	36in by 38.5in
Max. total weight authorized	2,600 lb
Fuselage capacity	110 cu ft
Payload for max. range	550 lb

Performance

	at 2,200 lb a.u.w.	at 2,600 lb. a.u.w.
Take-off run (hard surface, zero wind)	160 yd	220 yd
Take-off run, to clear 50ft	330 yd	450 yd
Landing run	140 yd	180 yd
Landing distance from 50ft	270 yd	295 yd
Initial rate of climb	—	730 ft/min
Best climbing speed	65/70 m.p.h.	70/75 m.p.h.
Max. cruising speed (2,300 r.p.m.)	107 m.p.h.	104 m.p.h.
Max. speed	123 m.p.h.	121 m.p.h.
Stalling speed, flaps up	—	58 m.p.h.
Stalling speed, full flaps (3rd position)	—	48 m.p.h.
Range		300 miles

AMBULANCE/FREIGHTER In the Air . . .

nose so high as to cause a stall with engine on. On the glide, control remains until a very low speed, and it calls for more than normal backward movement on the stick to get the nose up with flap down.

If the speed gets very low with part or full flap down and a load aboard, the rate of descent becomes high, and quite a lot of engine is needed to pick up speed again. A severe position-error of unknown magnitude made A.S.I. readings at the stall almost meaningless. As an indication, 30 m.p.h. on the clock was probably about 45 m.p.h. true. Stalling speeds with and without flap are in fact 48 m.p.h. and 58 m.p.h. true and at 2,600 lb a.u.w. respectively.

On the approach, with flap part lowered, a markedly nose-down attitude can be maintained without picking up excess speed, and so the view ahead is very good. As with most high-winged types, however, the view sideways and behind is not all that could be desired, but by looking all round before one starts to turn, and by sitting high and craning occasionally, the danger of collision need not be any greater than with other types of aircraft. Downwards, the view is, of course, excellent.

The elevators are light but positive for the round-out at about 55 m.p.h., and the touch-down is very easily made indeed. Without any conscious effort I was able to make three nice four-point touch-downs on the rough grass without bump or bounce.

I taxied back to the tarmac convinced that the A/F. can handle a variety of jobs with distinction, and was left with the impression that it is one of the most agreeable Austers I have flown. As old age creeps on, solidarity assumes new virtue; thus, to find a good-natured and tractable lightweight which contrives also to exhibit the robust characteristics of a much larger type was a very pleasant experience.

The makers have indicated a number of duties for the Ambulance/Freighter. They are as follows: *Military:* Ambulance, freighting, liaison, field-telephone cable laying, supply-dropping, field postal delivery and pick-up, aerial broadcasting direct to the ground, and aerial photography. (Examples of separate loads which can be carried are: 60 gal of drinking water; 85 gal of petrol; compo rations with biscuits for 120 for one day; blood-plasma for 80 men; 11 miles of field telephone cable; 80 rifles; 10,000 rounds of ammunition; 15 2in mortars or 150 2in mortar bombs.) *Civil.*—Flying-doctor service, passenger-carrying, freighting, pipe or power-line inspection and servicing, survey work, "flying shop," newspaper or mail delivery, crop dusting or spraying. For passenger and liaison work seats, for three people in addition to the pilot are bolted to the floorboards. The rear seat is of bench type and is, in fact, wide enough to take three abreast.

TEST PILOTS' PAY

The Views of the G.A.P.A.N. on a Significant Subject

READERS will recall that earlier this year, when the new salary-scale for Ministry of Supply test pilots was announced, *Flight* commented in a leading article (February 1st) on the emoluments offered not only to these men, but to test pilots employed by the industry and to those serving in the R.A.F. and Naval Aviation. We pointed out that employers have a responsibility beyond mere monetary payment to men whose active flying careers, for one reason or another, must perforce be brief. Now, somewhat belatedly (but for various reasons unavoidably so), Mr. John Lankester Parker, Master of the Guild of Air Pilots and Air Navigators of the British Empire, has indicated the reactions of the test-pilot members of that body to some of the points we put forward. In view of the importance of the subject, we give these remarks prominence here rather than in the correspondence columns. Mr. Lankester Parker, who was installed as Master of the Guild last December, is also a director of Short Brothers and Harland, Ltd., of which firm (and its predecessor) he was chief test pilot for nearly 30 years.

The Guild [writes Mr. Lankester Parker] is very grateful to *Flight* for its leading article "Fair Shares for Test Pilots"; I am sure that all test pilots are encouraged by the way their case was expounded and the importance of their calling emphasized. The article, unlike some recent Press comments, avoided the tendency—so unnecessary in our view—towards becoming an apologia for the implied over-high rates of pay now being earned by the Ministry of Supply test pilots.

Some of the statements, however, might be misunderstood, and our members feel that clarification is needed. It was implied that the test pilot carries less responsibility than the airline pilot and that, coupled with the fact that he is generally a younger man, the test pilot might be expected to receive a lesser reward. I am very much aware of the heavy responsibility carried by the airline pilot and of the arduous nature of his work, particularly in this climate. But it is surely given to few men to shoulder a greater responsibility than is borne by the test pilot of an important prototype—perhaps the only one in existence—of great cost in terms of money, time and effort. It is not only his job to fly this unknown type, but to fly it to the limits of its capacity, in an endeavour to eliminate dangerous tendencies and bring it to perfection. Failure to discover the limitations in time, or the acceptance of an unnecessary risk, might involve the aircraft and himself in disaster, and his company in heavy losses—and sometimes, indeed, the nation in a serious delay in its defence programme. *Flight's* leading article rightly stated that the M.o.S. pilot, because he has not the same advantages as airline pilots (and some industry pilots) in regard to insurance and pensions, should receive a higher salary. I understand, however, that the M.o.S. pilots do get the advantage of an Injury Warrant, common to the Civil Service, which, in effect, is a pension to the next-of-kin in the event of death on duty. They also get the benefit of a small gratuity at the end of their test-flying career.

There is another point about which there seems to be some misunderstanding: the value of the insurance cover. I cannot accept the view that the cost to the employer of the insurance premium to cover the test pilot for a given sum in the event of death or injury should be looked upon as an addition to his salary of the amount of that cost. For instance: two pilots might be in receipt of the same pay and insurance cover. One of them, engaged in more hazardous work than his colleague, would cost his employer a greater insurance premium. Are we to assume that the former was, in effect, receiving a higher salary?

For a considerable time the Guild has been perturbed at the apparent lack of appreciation, by at least part of the industry, of the importance of the test pilot. It has been using its influence to correct this attitude and generally to improve the conditions of his employment. It is proud of its reputation for fair and unbiased opinion. It has always refrained from washing any dirty linen in public and has no intention of departing from that policy now. The considerable publicity recently given to the subject of the welfare of test pilots has, however, forced our hand to the extent of making these observations.

Finally, to make quite sure that the Guild is not misunderstood, I would state that we are not a negotiating body with regard to terms of service; we do not suggest standard rates of pay for test pilots (their jobs are too varied and elastic for that); we do not encourage fantastic rates of danger-money—a test pilot is a volunteer, and proud of it; on the other hand, we cannot sit back and watch him being exploited. The Guild believes that the test pilot's future should be as assured as can be after his term of service in the air has been completed.

The time may come when the ideal test pilot will not require any initiative, nor more skill than is necessary to carry out precisely the drill laid down by the "boffins," and lack of imagination will do instead of courage. But that time is not yet. When, one day, the design and stressing of an aircraft is carried out by a faultless mechanical brain and the resultant product is flight-tested by a perfect Robot pilot, the Guild will not care how little credit either of them may get.

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Dassault Ouragan (France)
de Havilland DH.110
de Havilland Hornet
de Havilland Mosquito
de Havilland Vampire (Australia)
English Electric Canberra
Fairey Barracuda
Fairey Firefly
Fiat G.59 (Italy)
Fokker S.14 (Netherlands)
Gloster Meteors
Grumman Panther (U.S.A.)
Hawker Sea Hawk
Hawker P.1067
I.Ae. Nancú (Argentina)
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Nord 2200 (France)
North American Mustang (U.S.A.)
Short Sturgeon
Sud-Est Mistral (France)
Sud-Ouest SO.4000 (France)
Sud-Ouest SO.6021 (France)
Vickers Valiant
Vickers Supermarine Attacker
Vickers Supermarine 508
Vickers Supermarine Seafire
Vickers Supermarine Spitfire
Vickers Supermarine Swift

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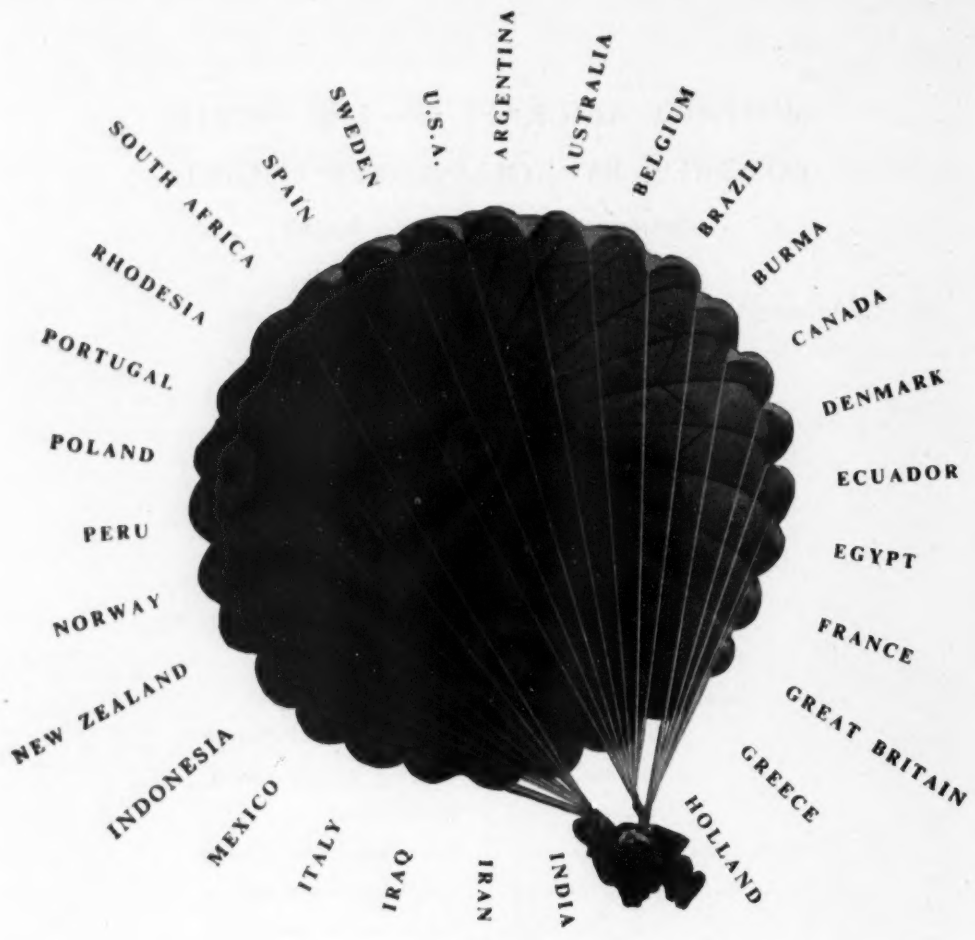
AERO ENGINES



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SUPER PRIORITY

Expediting the Vital Tasks: Aircraft Head the List

THE Government's plans for accelerating the rearmament programme, the subject of a preliminary statement in last week's issue of *Flight*, were announced in London on March 26th by Mr. F. C. Musgrave, C.B., Deputy Secretary, Ministry of Supply. Mr. Musgrave is administratively responsible within the Ministry for the development and production of aircraft. Known officially as the Super Priorities Scheme, the plan is intended to enable contractors engaged on "a small range of vital tasks" to fulfil their contracts without delay.

Super priority, said Mr. Musgrave, will be given to the following: the latest types of aircraft, i.e. the Hawker Hunter, Vickers-Supermarine Swift, one all-weather fighter [either the Gloster G.A.5 or de Havilland 110, according to the decision of the R.A.F.], English Electric Canberra, Vickers Valiant and Fairey Gannet; ammunition for aircraft; equipment for the radar chain; Centurion tanks; guided weapons; and certain items of the anti-mine programme.

The items named represent only 2½ per cent of the output of the engineering, metal-using industries. Priority in their manufacture will be effective over all other work, whether for exports, defence or home production, but it must interfere as little as possible with exports. If the scheme is not abused (spot checks will be made by the Ministry to ensure it is not), the effect on export trade is not expected to be serious.

Main contractors will be notified by the Minister of Supply, Mr. Duncan Sandys, of the contracts to which the priority applies. When it is necessary to ensure prompt delivery of components or materials, they should quote to sub-contractors the contract number, preceded by the full words "Super Priority," sending at the same time a copy of the Minister's letter. Sub-contractors will follow the same procedure when it is necessary. The trade associations principally concerned in the scheme are being informed of its significance, with the object of securing shop-floor priority of approved items. The Ministry adds a warning that abuse of the scheme might cause industrial dislocation; it must not be used to procure quicker or larger deliveries than are really necessary.

"Super Priority" contracts may be quoted (to employment exchanges) to recruit more labour and, if necessary, and after reference to the Ministry, to expedite completion or delivery of buildings and plant. Contractors will keep lists of firms which they authorize to use the symbol, enabling the Ministry to check the working of the system (which is intended to be voluntary, although legal sanctions exist).

At a meeting with leaders of the aircraft industry on the previous day (March 26th), Mr. Sandys asked them to extend sub-contracting as far as possible. In this respect, it was stated that many small firms are anxious to acquire super-priority defence contracts, but the majority lack the machine-shop facilities essential to modern aircraft production.

The machine-tool problem is not, of course, confined to small manufacturers. Some 23 per cent of the machine-tools ordered for the current defence programme (from the U.S.A., the Continent and in Britain) have been delivered, and deliveries are, on the whole, expected to keep pace with expanding production. Certain important machine-tools, however, are being operated on a 150-hour-week basis, at the Government's request; others may not be delivered for some months, and manufacturers are being urged to use all their ingenuity in finding alternative machining methods pending arrival of the vital equipment.

A problem of parallel urgency is the recruitment of 75,000 extra workers for the aircraft industry; skilled workers are required most urgently, for in many cases semi- or un-skilled labour is already available for work which cannot begin until skilled operatives are recruited.

The Government is unwilling to forecast in terms of months or years the hoped-for effect on production of the priority scheme. It is admitted that only one type [the Canberra] of the six named in the priority list is actually in production. To improve this situation is clearly an aim which deserves the support of the entire industry.

Concurrently with the Ministry of Supply announcement, the S.B.A.C. issued the following statement:—

"The Society warmly welcomes the decision the Government has now made to end the uncertainties which have so far impeded the achievements of the aircraft defence programme. Super priority . . . will run right down the production lines from the main contractors through equipment suppliers and sub-contractors to the material producers . . . and will equally apply to those Government agencies whose functions are an essential link in the specified jobs. The aircraft industry now joins in fullest co-operation with its official and industrial partners whose combined efforts are needed to make the scheme work. . . .

"There are other types of aircraft vital for the defence programme itself which the Government has not included in the super priority list, and there are exports of Service and merchant aircraft which add greatly to our security and our solvency as a nation. The aircraft industry will use every means to draw in extra men, materials and sub-contractors for this work, as they are freed from less essential activities. . . . The Government attaches the highest importance to exports of aircraft of all types, in which the British aircraft industry has an opportunity that must not be missed."

COLD AND DRY

WITH high-altitude flight becoming literally an everyday occurrence, intensive efforts are being made to develop equipment which will operate efficiently in the stratosphere.

The stratosphere may be defined as the part of the atmosphere in which temperature does not vary with height, remaining fairly steady at between —40 and —60 deg C at any given position; paradoxically, the lowest temperature recorded (—92 deg C) was over the equator. Such values can result in a reduction in the electrical conductivity of metals, upsetting the design-conditions for numerous electrical circuits. Strength considerations are not usually affected, since cold metals have good tensile strengths.

On the other hand, the temperature coefficient of expansion of a material may be sufficient to set up undue stress, particularly if dissimilar metals are rigidly joined together; a fuselage with a nominal length of 80ft can, on a tropical airfield, reach 80ft 2in, while a shrinkage to less than 79ft 9in can occur at high altitude.

On the fastest aircraft, the additional problem of aerodynamic heating has to be borne in mind; typical figures for a high-flying aircraft might be skin temperatures of —13 deg C at 660 m.p.h., +118 deg C at 1,320 m.p.h. and +335 deg C at 1,980 m.p.h.

The outer atmosphere is also characterized by an almost complete absence of water vapour. While this eliminates the possibility of icing—temperatures, also, are too low for this to occur—it can produce severe discomfort to aircraft crews. Not only does the human throat suffer from breathing such dry air but the exhaled air acquires peculiarly corrosive qualities; it can even cause damage and corrosion to the metal structure of the aircraft.

A possibly more immediate problem stemming from the absence of moisture is a great increase in the rate of wear of carbon brushes in electrical machinery. Such brushes have been developed to last for years at ground level, but the same patterns can actually erode by over half-an-inch per hour in the stratosphere. It is hardly practicable either to provide very large brushes or to change them in the air; the result, at present, can only be to limit the high-altitude duration of aircraft employing carbon brushes or contacts, the recent Canberra flights probably representing something near the limit with present apparatus. An obvious solution is to supply water to the commutator or brush, but it has been calculated that a turbojet heavy bomber would require at least 750 lb of water to do this effectively.

HERE AND THERE

Elizabethans in Service

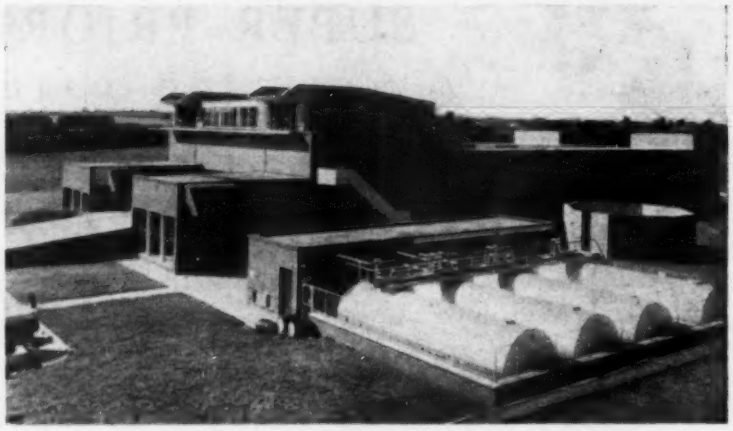
ON March 27th *Elizabethan* class aircraft began regular daily operation of two B.E.A. London-Paris and two Paris-London services. The services are the 08.00 hr and 13.00 hr ex London Airport and the 11.30 hr and 16.30 hr ex Le Bourget. The first day's operations were flown by R.M.A. *Sir Richard Grenville.*

Auxiliary Transport Squadrons

"CERTAIN difficulties" had been revealed during initial experience with the first of the Auxiliary Transport Squadrons, according to Mr. George Ward, Under-Secretary for Air, in the House of Commons last week. These difficulties, he said, had shown the need for substantial modification of the original programme, which now seemed rather too rigid. The formation of three further squadrons—in addition to the existing No. 622, operated by Airwork, Ltd., was under discussion.

Spectacular Record Attempt

OVER the Easter holiday a well-known racing pilot, T. W. Hayhow, will attempt to establish 18 new light-aircraft point-to-point speed records between London and six Continental cities. Flying a specially built single-seat Auster Aiglet (130 h.p. de Havilland Gipsy Major 1) from Elstree, he will first go from London to Paris and back non-stop, which should give him three records (London-Paris, Paris-London and London-Paris-London); later on the same day he will try for three similar records between London and the Hague. On the Saturday the target cities are Brussels and Luxembourg; on the Sunday Dublin is the aim; and on Easter Monday the objective is Amsterdam. Much cleaned up, the Aiglet has an Auster crop-spraying tank, fitted across the rear seats, as an overload fuel tank (giving 61 gallons in all, or six hours at cruising speed); an Arrow-type (small-wheel) undercarriage; simplified strut-bracing; a Decca Navigator; and Murphy MR60 V.H.F. radio.



CAPACITY FOR THE FUTURE: Designed specifically for turbojets of greater power than any at present existing, this fine building is both the largest and most modern of the Bristol Aeroplane Company's (Engine Division) test houses.

Turn it up!

THE index to Vol. LX (July-December, 1951) of *Flight* is now available, price 1s (by post, 1s 2d) from the publishers, Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. A binding case, with the index, is obtainable at 6s 5d including postage.

Progress of the "110"

GOOD news of the D.H.110 comes from the April issue of the *de Havilland Gazette*—". . . this swept-wing two-seat fighter, which is the outcome of high-speed research with the D.H.108 . . . is already beginning to establish on test its potentialities as a worthy successor to the Vampire and Venom . . . flight trials are proceeding apace and expectations have been surpassed. It will prove a potent weapon of great versatility, capable of matching or even exceeding the performance of its single-seater contemporaries, with the additional advantage of long endurance and the ability to operate irrespective of weather or darkness." The *Gazette* also refers to future developments in the field of clear-weather intercepters, stating that the "new British prototype single-seaters . . . and their linear developments may well remain dominant until the rocket fighter, and eventually the guided missile, emerge as practical weapons."

Super-Priority Progress

THE Air Ministry has also stated that trials of the D.H.110 and Gloster G.A.5 were still proceeding but that no order would be placed until results were available. Certainly one or both will be placed on the super-priority list very soon, and present indecision is unlikely to hold up the overall programme. This is being aided by the decision of local authorities to apply for additional housing allocations for workers.

Snowdonia Accident Inquiry

A PUBLIC inquiry into the loss of an Aer Lingus Dakota in Snowdonia on January 10th has been ordered by the Minister of Civil Aviation. It will be opened in London on April 17th by Mr. Ronald Adams, Q.C., sitting with Capt. W. B. Caldwell and E. Gold as assessors.

Conservative Committees

THE election is announced of A.Cdre. A. V. Harvey, C.B.E., M.P. for Macclesfield, as chairman of the Conservative civil aviation committee in succession to the Hon. George Ward, M.P., who was recently appointed Under-Secretary of State for Air. A.Cdre. Harvey will continue as chairman of the air sub-committee of the party's defence committee.

D.H. Propellers and the Future

COMMENTING on our report, last week, of the annual general meeting of de Havilland Propellers, Ltd., that company points out that a reference to future developments might have been misconstrued. Notwithstanding the new guided-missile commitment, the company will press forward energetically with its propeller programme, for (as the chairman observed in his report) though jet propulsion will probably become general for trunk services, there will always be a larger volume of second-class traffic for which airscrew-driven aircraft will be more suitable for a long time to come. Also, in publishing

JET-AGE AIR TICKET: B.O.A.C. has prepared a specially designed passenger-ticket cover for its Comet services. The design, shown here, is mainly in pale grey and blue.

portraits of Messrs. R. E. Bishop and G. C. I. Gardiner, appointed directors of the company, we should have made it clear that the latter was chief engineer of de Havilland Propellers, and not of the parent company.

Oriental Let-up

THE peace treaty between the Allied Powers and Japan, which was signed last September and came into effect this week, automatically removes all the restrictions enforced by the former occupation authorities. Permission has been given for the aircraft industry to begin production of both civil and military aircraft although, under the terms of the surrender, they may not be flown by Japanese pilots. Details of Japanese airline plans appear on page 420 of this issue.

Ice-island Landing

IT was disclosed in Washington last week-end that three U.S.A.F. men have been left to make weather observations on a floating ice-island between 60 and 100 miles from the North Pole. They were put down by a C-47 which landed on the floating airfield on March 16th and which later took off successfully. The island is undoubtedly one of the three which formed the subject of an exclusive article in *Flight* of February 22nd.

In Public

ON Wednesday, April 9th, Mr. George Edwards, chief designer of Vickers-Armstrongs, Ltd., Aviation Division, is to lecture on *Current Problems in Aircraft Design*, at Sutton (Surrey) Public Hall, at 8 p.m. Although he has frequently addressed the learned societies, this is probably one of the first occasions on which he has given a lecture open to the public. The meeting has been organized by the Surrey Branch of Air Britain, the chairman of which is G C. W. N. Cumming, O.B.E., D.F.C., A.F.R.Ae.S.

The Wooden Horse: Tragic Sequel

AMONG 12 people killed in a terrorist ambush on the Perak-Selangor border last week was Mr. R. M. C. Codner, who was one of the three R.A.F. officers who made the famous "vaulting-horse" escape from Stalag Luft III. Mr. Codner joined the Malayan Civil Service in 1950 and was an assistant district officer at Tanjong Malim, the village near which the ambush took place. He was "John Clinton" in Eric Williams' book, *The Wooden Horse*, which told the full story of the escape. General Templer, Malaya High Commissioner, flew to the village later in the week and announced penalties to be imposed on its inhabitants, who had refused information about the terrorists.

PRIMARY OR STATIC: A new primary glider, utilizing many components of the Cadet Mk. 1 Trainer, has been designed by Slingsby Sailplanes, Ltd. It is seen here on the ball-joint tripod which converts it into a static trainer, the controls becoming effective in a light wind.

Single-engine Performance

PROPELLED solely by her gas turbine alternator, the Shell tanker *Auris* recently arrived at Curaçao after crossing from Plymouth at an average speed of 7.18 kt. With her full propulsive power (there are also three diesel generators) the *Auris* has a designed speed of 12 kt.

Millions for Missiles

THE head of U.S. Army research on special weapons, Brigadier-General S. R. Mickelson, recently gave evidence—made public last Monday—before a Congress sub-committee drawn up to consider budget requests. He said that the Research and Development Division required over £160 million for the financial year beginning on July 1st, of which over £10m would be spent on continued experiments on surface-to-air guided missiles and allied equipment. This part of the programme, he said, was designed "to provide weapons which will be capable of destroying enemy aircraft at all altitudes up to 80,000ft and at ranges several times those possible with conventional anti-aircraft artillery.

IN BRIEF

THE Air Registration Board has recently approved an extension of overhaul life of the Gipsy Queen 70-4 (as used in the Dove, Marathon and Sealand) from 600 to 800 hours.

* * *

On April 1st, International Aeradio, Ltd., opened an air-traffic control school at the Belgian Air Force station at St. Trond. An I.A.L. traffic-control synthetic trainer has been installed, and it is hoped to turn out fifty qualified controllers a year.

* * *

Sangamo Weston, Ltd., the instrument manufacturers of Enfield, Middlesex, have opened a London office in a new block recently erected near the junction of New Oxford Street and High Holborn. The address is : St. George's Court, 22/26, New Oxford Street, London, W.C.1 (Chancery 4971).

* * *

Wolf Electric Tools, Ltd., Hanger Lane, London, W.5, have produced a colour film-strip showing how portable power tools can best be employed to speeding-up production. Organizations showing the strip can also have the services of a lecturer to enlarge on the various points with which it deals.

* * *

From British Insulated Callender's Cables, Ltd., Norfolk House, London, W.C.2, comes a catalogue of mass-impregnated non-draining cables for ground installations. These cables are designed to overcome the disadvantages of insulating compound flowing downwards through the cable-structure on vertical or steep runs.

* * *

Lt.-Cdr. (L) W. R. Hayward, R.N.V.R., of Venner, Ltd., is now on his way to visit the company's American associates; thence he will go to Canada, where he will join, as sales manager, the executive staff of the newly formed company, Silvercel of Canada, Ltd. Since he joined the British company he has been making an intensive study of the potentialities of the Venner silver-zinc accumulator.

ROYAL VISIT: H.R.H. The Duke of Gloucester, who recently paid a surprise visit to the Willesden factory of the Triplex Safety Glass Co., Ltd., watches a router-operator machining a cabin window for a B.O.A.C. Argonaut. At the corner of the work-table is Mr. C. L. Cripps, works director.

SMALL FLYING-BOATS in AFRICA

A Pilot's Proposals for Lake and River Services by Sealand

By HOWARD FRY

THE author, an experienced airline pilot, believes that small flying-boats could be operated in Africa on profitable feeder-line and "sight-seeing" services. He suggests that the projected flying-boat version of the Sealand amphibian would be a suitable aircraft (over 800 lb lighter than the amphibian, a Sealand Mk 3 flying-boat could carry ten passengers over 300-mile stage-lengths, or fewer passengers on some of the longer routes proposed by the author). Capt. Fry has suggested to us that a small jet unit might be fitted in the rear of each nacelle, thereby improving take-off in high temperatures or from high-altitude lakes, and also increasing the one-engine-out safety factor. The idea, a little far-fetched at first sight, is supported by news of serious proposals to improve performance of Dakotas and certain other twins by the installation of small Turboméca turbojets.

FROM 1937 to 1947 South Africans, Rhodesians and East Africans regarded the old Empire flying-boat as their own particular form of air transport. Later the Solents, while linking England and South Africa, brought air transport to Livingstone and Cape Maclear in Nyasaland. Now it seems that the day of the flying-boat is over—so far as the main trunk routes are concerned.

Regardless of all the arguments advanced against the "old boats," South Africans and their northern neighbours still have a lot of affection for them. The purpose of this article is to consider whether there may not still be a place for the small feederline boat on Africa's miles of lakes and rivers.

One of the drawbacks to flying-boat operation in Southern Africa used to be the size of the aircraft; 30- or 40-seat types were too large to fill on the East African coastal routes or on flights between the inland lakes. But Short Brothers and Harland, Ltd., have developed the Sealand Mk. 3 flying-boat, which is capable of carrying eight passengers, baggage and mail on stages of up to 550 miles. This little aircraft might well fit into the general transport picture in Africa, where suitable feederliners are scarce. The main characteristics of the Sealand as the projected pure flying-boat version, as opposed to the amphibian—are summarized in the following table :—

Engines: Two D.H. Gipsy Queen 70-3 (each 325/340 h.p.)	
Empty weight (inc. 8 seats and toilet)	6,500 lb
Take-off weight	9,100 lb
Normal fuel capacity	115 gal
Consumption	6 m.p.g.
Cruising speed	127-170 m.p.h.
Take-off run	630 yd
Alighting run	400 yd
Maximum passenger load	10
Maximum freight load	2,080 lb

The Sealand is a small, easily handled aircraft for which a one-man crew is sufficient. It is fitted with V.H.F. R/T. and voice communication can be maintained with existing radio stations at airfields. On the water, reversible-pitch airscrews give an ease of control which was lacking on earlier boats. The pilot himself can moor the aircraft to a buoy without difficulty, and the Sealand's very high degree of manoeuvrability enables it to be taxied directly into a U-shaped embarkation pier.

In using Sealands for African feeder services, it would be essential to keep staff and equipment, on shore and water, to a minimum. The aircraft should operate only to and from stretches of water where motor launches can be hired. Thus the only equipment owned by the operators would be the V.H.F. radio set on the hired launch and the flying-boat's mooring buoy. The services of the launch and the coxswain would, of course, be required for only one hour to cover the landing and take-off. Naturally it would be necessary to engage a local business firm at each stop to act as commercial agents.

The Short Sealand: as the author suggests, a flying-boat version of this versatile little amphibian would be a likely choice for the African feeder-line services proposed in his article.

The Sealand hull is a straightforward design planned for easy maintenance. For example, all the control runs are grouped together in a single channel along the top of the hull. Inspection and lubrication are thus quick and easy. Similarly, the Gipsy engine is noted for its reliability. Running maintenance is simple and very similar to that required on a car. Pilots engaged to fly Sealands might, not unreasonably, be asked to take Engineers' Licences for the aircraft.

Naturally, the home base for the small boats would have to be at some place where a slipway and hangar were available. These could be constructed easily and cheaply at the Huygani Dam, Salisbury, where the non-tidal water would be an advantage. The only points in Africa where slipways already exist are Kisumu, Mombasa and Durban, though it is possible that the launch slipway at Vaaldam might be strong enough. Whatever point was chosen for the main base, it would obviously be necessary to engage a really keen engineering staff—well-qualified and correspondingly well-paid (preferably on a profit-sharing basis).

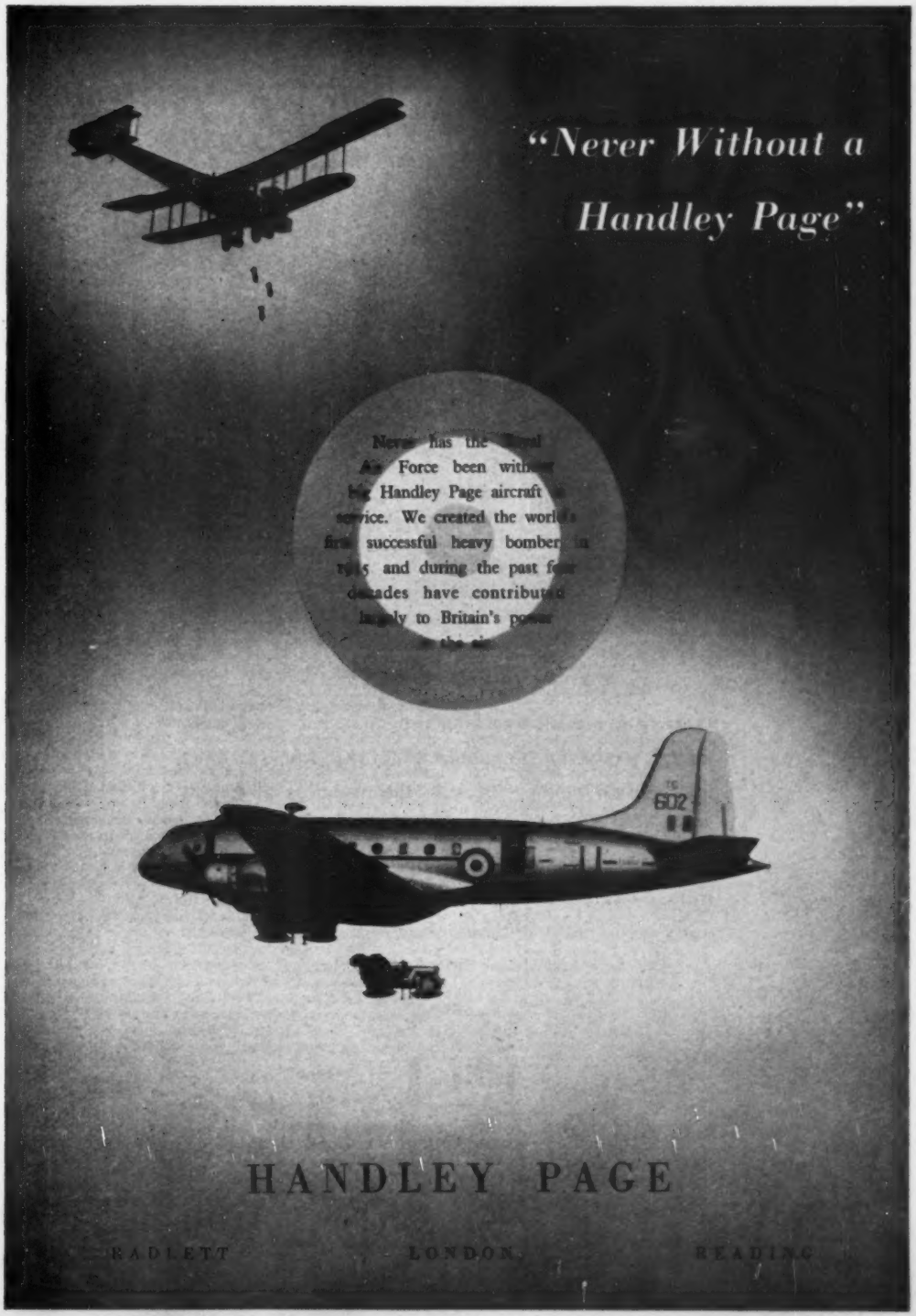
Durban is the obvious centre for flying-boat operations in South Africa, but there would be advantages in running some services to Hartebeestepoortdam. The latter stretch of water is in attractive country about 20 miles from Pretoria. Possible services would be :—Durban—Hartebeestepoort; Durban—Port St. Johns (Umzimvubu River); Durban—St. Lucia Bay—Lourenço Marques; Durban—Loskop Game Reserve; Hartebeestepoort—Loskop Game Reserve.

Until recently, the flying-boat was of little use for communications in Rhodesia because no stretch of suitable water existed near Salisbury. Now a dam has been built on the Hungani River (12 miles from the city) and about 2½ miles of water is available for use as an airport.

Future possibilities for the flying-boat in this area are widened by the construction of a big new hotel directly on the Zambezi at Victoria Falls. Thus a flying-boat link with Salisbury would enable citizens of the capital city to travel direct to the hotel, with no long bus ride such as that from the land airport to the Falls Hotel. The lake holiday resorts in Nyasaland can similarly be reached direct by flying-boat, whereas a landplane service involves a tedious bus ride.

Possible services in Rhodesia and Nyasaland are :—Salisbury—Victoria Falls; Salisbury—Cape Maclear and other Lake Nyasa resorts; Salisbury—Lourenço Marques; Cape Maclear—Lindi or Mikindani—Dar-es-Salaam.

A service linking Lake Nyasa with Dar-es-Salaam, Lindi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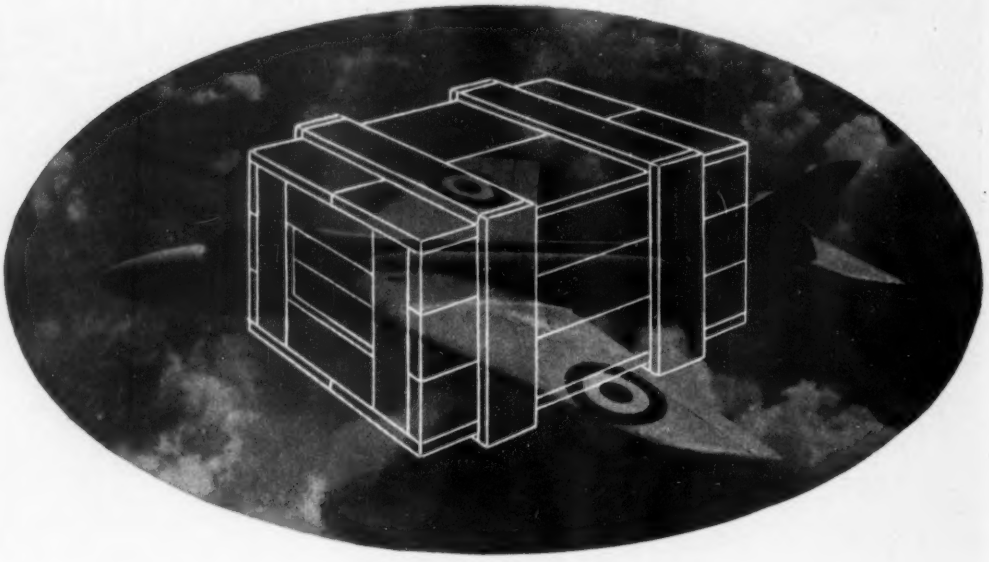

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SMALL FLYING BOATS IN AFRICA . . .

and Mikindani might be welcomed by residents of Tanganyika. A short holiday in the cool beauty of Nyasaland would certainly be attractive to those confined to the humid Tanganyika coast.

The small flying-boat might also find work in Africa by restoring the old-fashioned, sight-seeing, night-stopping flights which were once so popular. The interesting part of Africa is that south of the Equator. Many passengers bound for Europe might like to make a leisurely trip through the Great Lakes before joining the main line at Entebbe. A suggested route for such a service is from Durban to Lourenço Marques, Salisbury, Cape Maclear and Deep Bay (Nyasaland), Kasanga and Ujiji (Lake Tanganyika), Mwanza (Lake Victoria) and finally to Entebbe Airport (Uganda).

The time-table for such a "puddle-jumping" service might be as shown at the top of col. 2 :—

L.S.T.		Distance and Fare		L.S.T.
17.30	Durban	283 miles	£5 10s.	07.00
15.20				09.10
14.45	Lourenço Marques	557 miles	£11 0s.	09.45
10.30				14.00
09.55	Salisbury	382 miles	£8 0s.	14.35
07.00				17.30
16.00	*Cape Maclear ...	250 miles	£4 15s.	07.00
14.00				09.00
13.25	Deep Bay	242 miles	£4 15s.	09.35
12.15				12.35
11.50	Kasanga	270 miles	£5 5s.	13.10
09.40				15.20
09.05	Kigoma	260 miles	£5 0s.	15.55
09.00				18.00
15.35	*Mwanza	200 miles	£4 0s.	09.00
14.00	Entebbe	... ...	...	10.35

* Dinner and night-stop in each direction.

NOTE.—Additional calls might be made, as required, at Albertville (Belgian Congo) and Bukoba (Tanganyika).

The fare-structure is based on a direct operating cost of 2½d. per passenger mile. This has been considered to correspond to approximately 4.7d. per passenger-mile for total operating costs and average load factors. In addition to the above fares it would be necessary to add approximately £3 per passenger per day for meals and night-stop accommodation. It might be argued that the big airlines would object to the service envisaged. I believe, however, that they might well realize that it caters for a different public and serves different areas.

The small flying-boat may serve a very useful purpose in linking the communications which already exist along Africa's lakes and rivers. The writer believes that it may also encourage greater development and white settlement in these regions. Hundreds of people may thus come to bless the day that the flying-boat came back to Africa.

CANADA'S AIRCRAFT INDUSTRY

Famous Names and a Mighty Potential. Part I: The General Picture

By JAMES HAY STEVENS

THIS is the first of a series of articles written by our contributor on his return from an extended tour of Canada, during which he has visited a large number of factories. In this opening part he describes the general condition of the aircraft industry in the Dominion, and gives the location of the various manufacturing centres. In future instalments he will describe the work of a number of individual firms. This and the succeeding articles will, we think, provide a useful work of reference for members of the British industry who are likely to have dealings with their Canadian opposite numbers.

POTENTIALLY one of the greatest aircraft manufacturing countries in the world, Canada today presents a complex and interesting picture. Everyone foresees the brightest of futures, and none is more enthusiastic than the Canadians themselves; but it would be a brave man who would forecast the eventual form and substance of the industry.

Between the wars, mainly because of her geographical and topographical characteristics, Canada was one of the world's largest aircraft-users. Because of the very peculiarities that made aviation an essential mode of transport, the Dominion was also largely restricted to small "bush" aircraft of practical and rather unrefined design, little suited to customers in other countries. Thus it was that in 1939 there was a domestic industry consisting of a few small companies making specialized small aeroplanes in small quantities.

With the advent of war, the Canadians threw themselves into the task of building aircraft with the same purposeful energy which they applied to every other aspect of the struggle. The industry, despite the growing-pains of rapid expansion, assumed vast proportions and supplied a large quantity of material to the Allied air forces. As in other countries this expanded industry consisted both of established aircraft firms, enlarged with Government assistance, and other manufacturers co-opted for the duration.

Again in harmony with other nations, the Canadians hoped to throw their armament burden overboard after the war. Orders were cancelled, the R.C.A.F. was largely demobilized, and staffs were drastically cut in the aircraft firms, while the "outsiders" returned to their original fields —in some cases, not without relief.

For several years—until NATO was established, in fact—the Canadian aircraft industry continued to be uncertain whither it was bound. This was not because of any lack of faith in itself—self-confidence without conceit is a fundamental of Canadian character—but was due to a well-founded mistrust in the ways of politicians and the committee of nations. However, even after the havoc of peace had been wrought, there remained a sound nucleus industry, with just about enough work to keep it solvent.

Now the industry is again expanding rapidly—but not, fortunately, with the cataclysmic violence of 1939. The capacity of a giant is there and it is being gradually and methodically brought into play. Behind this expansion lie the policies of the Hon. Brooke Claxton, Minister of Defence, and the Hon. C. D. Howe, Minister of Defence Production, the first with his forty-squadron air force and NATO training programmes, the latter organizing and directing the expansion of the industry.

The companies forming the core of the Canadian aircraft industry are of three basic types: the indigenous Canadians, the British-sponsored and the U.S.-sponsored. It is very significant that major British and American aeronautical groups are showing an ever-increasing interest in the Canadian field. At first concerned mainly with establishing servicing centres, the daughter firms are now assuming an importance equal to that of their parent companies.

One of the first factors that one notices when visiting Canada is the space available. Unlike this country, floor space is not at a premium and, when there is insufficient, more is provided. Building work is rapid; materials are not scarce; labour, although expensive, is on tap—and permits are not required! Naturally, one hears complaints of lack of space from production engineers, and it is a curious anomaly that although floor areas are so much greater (and often so much more convenient) than in this country, most of the work is laid out tidily and with economy of space.

While on the subject of space, it is impossible to overemphasize this fundamental difference between Canada and Britain. In every activity, the contrast is as marked as is that between one of our back gardens and the prairies themselves. Nothing is cramped in Canada; there is always more land to be used, while, of course, a journey of 250 miles signifies no more than one of 25 miles in this country. By contrast, a car will be used to go a quarter of a mile from one building to another in the same factory!

Labour, both local and immigrant, is available for the

CANADA'S AIRCRAFT INDUSTRY . . .

industry at its present size, although there will be a shortage later as the expansion grows. Part of the greater requirement will, however, be met by the spreading of the load among manufacturers of non-essential goods. For example, the Ford Motor Co. of Canada (Windsor, Ont.) is to make the wings of the T-33 for Canadair. Since the Government is restricting steel supplies for automobiles, the aircraft work will enable this firm to retain its men—but they are already advertising for experienced aircraft workers to supplement their regular labour force.

There is in the Montreal area a stabilising factor in the French Canadian. While in many parts of Canada there is a tendency for men to move about—rather in the U.S. fashion, where a man will change his job every few years—this is not the case in Montreal. Like his forbears, the French Canadian is deeply attached to his home and dislikes moving. This means that he will stay on in any job that is secure. He is a very good workman—tending, even to-day, to be a craftsman—but he has generally no very high ambitions. He is usually content to progress to lead hand or foreman, and seldom has an eye on an eventual executive post.

Then there is another aspect that is causing intense worry in Canada. Last year the big three (Avro, Canadair, de Havilland) scoured Britain and the Continent for recruits—both technicians and tradesmen. They had considerable success and they have also had numerous recruits from among the D.P.s who have completed their obligatory year on the land. But the U.S. is even more hard-pressed for skilled personnel and there is a steady drift over the border.

This "leakage" takes two forms. There are the energetic efforts of the American companies to suborn the established and experienced Canadian aircraft engineer and there is the planned "desertion" of many of the immigrant engineers. Wages are higher in the U.S.A., and therefore they are an inherent attraction, despite the higher living costs there. To this is added the seductive advertisements of the Californian companies who even offer a preliminary week-end tour of inspection *for the whole family*, as well as guaranteed housing, cost-of-living bonus, a five-year contract and full removal and travel expenses !

To key personnel a direct offer may come in the post and, if this is not accepted, the salary offered will be raised by return of post. Such high-pressure attacks are difficult to resist, particularly where the sunny climate of California is extolled as an added inducement, with pictures of the inevitable bathing-beauties.

Many immigrants from Europe appear to have a planned programme by which they use Canada as a stepping-stone to the States. It is easier to enter Canada than the U.S.A., with its strict quota system, but, once established as a Canadian, it is simple to enter the States, for the famous undefended frontier is scarcely any barrier in either direction.

A curious feature of Canadian aircraft manufacture is the general absence of incentive bonus or piecework methods of payment. The opinion expressed to me in more than one factory was that the enthusiasm and interest of the workmen was such as to respond to encouragement and admonition without recourse to cash reward. The basic rates of pay—around $1.50 (a little over 10s.) an hour for skilled trades—are high and there is plenty to buy, so that people do have a greater will to work more than in this country today. Yet it was difficult to believe the assertion that Canadians were too independent in spirit to accept bonus or piecework—particularly as I found that such methods are in use in other engineering industries.

That, then, is the picture of Canadian aviation in general, and now it is time to turn to the particular.

The R.C.A.F. and Canadian Naval Aviation to-day are equipped almost exclusively with obsolete or obsolescent aircraft. This fact also helps to set the pattern of the industry and its expansion. It means that a very large part of the production capacity is being dissipated on the repair, overhaul, reconditioning or conversion of Lancasters, Mitchells, Harvards, Dakotas, Mustangs, Expeditors, and so forth. The potential is there, but the orders are not—as yet.

As I have said, distance means little to the Canadians and their industry seems to us a sprawling affair; yet it works efficiently and the hundreds of miles of separation seem to be little handicap.

Ignoring for the moment the sub-contractors and other firms doing aircraft parts as a sideline, there are two centres of the Canadian industry—Toronto and Montreal. Toronto is the home of A. V. Roe (Canada) Ltd., at Malton Airport, and de Havilland Aircraft of Canada, Ltd., at Downsview Airport. Also at or near Toronto are several smaller firms, such as Sanderson Aircraft, Ltd., Dowty Equipment of Canada, Ltd., Lucas-Rotax, Ltd., Canadian Steel Improvement, Ltd., Canadian Flight Equipment, Ltd., the Canadian General Electric Co., Ltd., Carrière and MacFeeters, Crystal Glass and Plastics, Ltd., Field Aviation Co., Ltd., Inaerco, Ltd., Prenco Progress and Engineering Corp., Ltd.; all of these deal mainly in aircraft work, while there are many others doing aeronautical sub-contracting as a sideline.

Also virtually in the Toronto area are the companies in the peninsula which lies between Lake Huron, Lake Erie and Niagara Falls. Among the most important of these are Fleet Manufacturing Ltd., at Fort Erie; Cockshutt Farm Equipment, Ltd. (Aircraft Division), at Brantford; Thompson Products, Ltd., and Genaire, Ltd., at St. Catherines; and, of course, the Canadian Ford company at Windsor.

The Eastern stronghold of aviation, Montreal, has the plants of one of the big three, Canadair, Ltd., at Cartierville and Dorval; then there are two factories of the aviation division of the Canadian Car and Foundry Co. Ltd.; Canadian Pratt and Whitney Ltd.; Bristol Aeroplane Engines (Eastern), Ltd.; Rolls Royce (Montreal), Ltd.; the Sperry Gyroscope Co. of Canada Ltd.; Aircraft Industries of Canada Ltd.; Aviation Electric Ltd.; and Godfrey Engineering Co., Ltd. These again, are all major manufacturers and repairers of aircraft, engines or equipment and the list takes no account of the many firms sub-contracting aircraft work.

In addition to these main centres there are several isolated aeronautical outcrops of no mean proportions. At Winnipeg, on the verge of the prairies, there are MacDonald Brothers Aircraft, Ltd., Standard Aero Engines, Ltd., Northwest Industries, Ltd., and the Trans-Canada Airlines overhaul base. Canadian Car and Foundry's main plant is at Fort William on Lake Superior. On the West Coast there is, of course, Bristol Aeroplane Engines (Western), Ltd., at Vancouver and the Canadian Pacific Airlines overhaul base. Finally, coming to the other extreme geographically (over 3,000 miles in fact), there is the Fairey Aviation Company of Canada, Ltd., at Eastern Passage, Nova Scotia, five miles from Halifax.

This list, which contains many famous names with historical connections in aviation, gives a good idea of the spread of the industry in Canada. It is obvious, too, that from the location of the aircraft firms the whole organizational problems of labour and material are essentially different from those in this country. While moving components, or changing a job, from Montreal to Toronto is about the same as making a shift from London to Newcastle, the distances to the other plants are far greater.

It must also be remembered that while it is all Canada, the way of life in the different provinces varies greatly. The changes in everyday life between Toronto and Montreal are more nearly akin to those of London and Paris than to those of London and Newcastle. The West, such as Winnipeg, again has its own ways; life there is much more brusque and sturdy than in Toronto, for instance. Because of these factors the migration of labour is limited and, in general, expansion must find its personnel locally. There are not so many, or such advanced, technical schools as in Europe and most companies have to do a considerable amount of training of recruits.

It would be wrong to conclude this general survey without a mention of climate, which is subject to many misconceptions; even in the U.S.A. the Canadian weather is largely a mystery. Like the Aberdonian's meanness, the legend of the Canadian climate is largely a popular distortion fostered by the native. As far as industry is concerned, the heat of the summer, when both Montreal and Toronto suffer from rather high humidity, is probably the greatest deterrent to work. The heat is sub-tropical, but is scarcely worse than is met with in the south of France, although, of course, it does make a strong contrast with the cold winter.

(*To be continued*)

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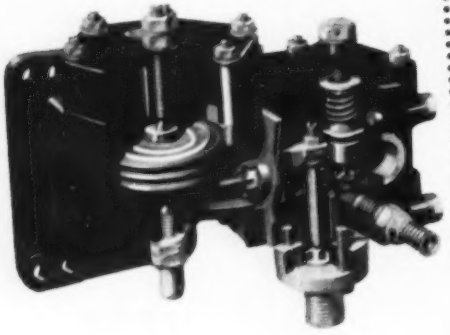

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MILITARY AIRCRAFT of the World

By H. F. KING, M.B.E.

THIS appreciation is written at a time of unprecedented activity in the design and construction of military aircraft. While the air forces of the Powers are expanding and re-equipping, new tactics and operational techniques are being developed with the greatest urgency for the more effective employment of this new strength.

Coincident with this awesome and somewhat bewildering renaissance of air power there has come about a general tautening of security restrictions, and though, as the following pages will testify, the Western Powers are still sufficiently open-handed with technical information to allow discussion in some detail, the task of gathering material for study has been noticeably more difficult than on former occasions.

Though only about two years have passed since the preceding review (*Flight*, January 26th, 1950), some highly significant developments can be recorded—not all of them, unhappily, with satisfaction. In Korea the Communists have matched their Russian-built Mig-15s against the best fighters the U.S. Air Force and Navy can put into the air against them, and among which only a single type—the North American Sabre—has been able to compete in performance. Fortunately, however, the outcome of an air battle need no longer be decided solely by the qualities of airframe, power plant, pilot and guns, and in large measure the numerous victories credited to the slower American fighters can be ascribed to a newly developed automatic computing gun-sight. This, it would seem, has proved as decisive a factor as did the gyro gun-sight on British and American fighters towards the close of the last war.

But Russian progress has not been confined to fighters, for in Germany substantial numbers of twin-jet bombers have been observed, while at Russian bases some hundreds of B-29-type piston-engined machines are on call. At least one new long-range bomber, and other prototypes for a wide range of military duties, have been reliably reported. The most regrettable aspect of Russia's impressive technical advancement is that it should have been greatly facilitated by power plants of British origin.

In our own country the most significant developments of the past two years are without question the Hawker Hunter and Supermarine Swift and Type 508 single-seat fighters; the Gloster G.A.5 and D.H.110 multi-purpose heavy fighters; the Vickers Valiant four-jet bomber; and delta-wing research machines by Avro, Fairey and Boulton Paul, which can hardly fail to exert a powerful, though at present incalculable, influence on the design of future Service equipment. New British trainers and the unique Blackburn and General Aircraft G.A.L.60 military freighter have also made a favourable impression—and not in this country alone. Two-seater jet-propelled night fighters are at last in squadron service, as are three variants of the English Electric Canberra jet bomber; but, on the other hand, the Royal Navy still awaits its twin-turboprop Fairey Gannet anti-submarine hunter/killers, upon which such a weighty responsibility will ultimately devolve. In brief, Britain can now display a comprehensive range of advanced prototypes, many of them unsurpassed in their own class, though from this range there are still a few absentees. Among these a modern type of military flying-boat is especially regretted.

The production picture in Britain, as the world is well aware, gives far less cause for satisfaction; in these pages, however, we are concerned only with the aircraft themselves and not with the factors governing their availability.

With characteristic energy and imagination America is throwing her mighty resources into the quantity production of first-rate machines, outstanding among which are the Boeing Stratojet, Convair B-36 and Martin (English Electric) B-57 bombers; late-series North American Sabre and Republic Thunderjet single-seat fighters; Northrop Scorpion and Lockheed F-94 all-weather two-seater fighters; and Chance Vought Cutlass and McDonnell Demon deck-landing fighters. Prototypes of special note include the massive Boeing XB-52 bomber, the comparable Convair YB-60, and the delta-wing Douglas Skyray fighter.

To America, also, credit is due for introducing a new class of heavy carrier-borne attack aircraft (North American Savage and Douglas XA3D) and for placing in experimental service the first pilotless bombers (Martin Matador). The U.S.A., moreover, has shown commendable initiative in exploiting helicopters for military purposes and in developing very large long-range military transports, among which the Douglas Globemaster is especially noteworthy.

North of the American border, in expanding factories, the formidable long-range Avro Canada CF-100 heavy fighters are already coming off the production line, as are American-designed Sabres, licensed to Canadair. Simultaneously there is a steady southward flow of de Havilland Beaver liaison monoplanes for the American Armed Services and in due time the Beavers will be followed by later, larger types.

Nearer home, in Sweden, the excellent swept-wing Saab-29 single-seaters are established in the squadrons, and some advanced ground-attack techniques and equipment are reported. The most notable prototypes now flying in France are the Dassault Mystère fighter and the Bréguet Fulgur.

INTERCEPTION, escort, and battle-area action against air and terrestrial targets are the primary duties devolving upon the fighters now in service, and to a surprising extent these nominally specialized functions are flexible, the *soi-disant* intercepter of one year frequently masquerading as the army-support fighter/bomber of the next. The truth of the matter is that most fighters now in use are "all-rounders" and as often as not their employment is dictated by their shortcomings rather than by their merits.

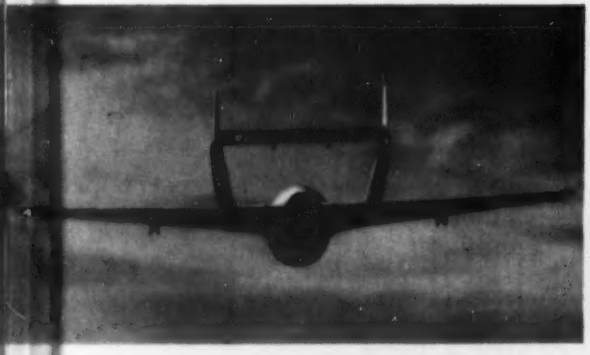
It is not possible to picture the future and culmination of fighter development with any great degree of confidence or precision, so many and varied are the circumstances and requirements bearing upon it; but what can be foretold with tolerable certainty is that all fighters will henceforth be propelled by turbojets, rockets and/or ramjets. The turboprop and ducted fan hold greater promise as applied to attack, bomber and intruder aircraft, for in such machines long endurance—perhaps at ground level—is mandatory.

So far is is known, there are no fighters in general service which use rocket or ramjet propulsion as a primary, or even secondary, source of power, and, apart from a seemingly insoluble residue of piston-engined Spitfires, Mustangs and early Yaks, to which the appellation "fighter" is allowed more from sentiment than from fitness, the vast majority of fighters today are propelled by one or two turbojets. On some the wings and tail surfaces are straight; on others, moderately swept. Some are single-seaters; others—designed for night and/or bad-weather operation—carry a crew of two. A few have radar; the rest are still dependent for success on the pilot's acumen, skill and fortitude, aided in some degree by direction from the ground. All carry multiple automatic guns as their primary armament.

It is the more important of these machines (irrespective of whether they be land- or ship-based) which are listed in the table herewith and which will be considered—solely as fighting aircraft—before later prototypes and future possibilities are discussed.

Of the machines listed, the Vampire, Venom, Meteor and F-94 and Thunderjet date in design from the war, though radical modifications have been introduced to augment performance; thus, the Venom and the newest F-94 employ a wing of thinner section than formerly. But notwithstanding their dated design, these are the fighters, together with the somewhat later F-86 Sabre, which would have to bear the brunt of any large-scale air fighting during the next two or three years. Each is therefore deserving of evaluation, particularly in regard to performance, armament and equipment; and the only worthwhile yardstick is the Russian Mig-15.

General Vandenberg, Chief of Staff, U.S.A.F., has judged that



D.H. Vampire F.B.5 (Goblin 2). (Below) Supermarine Swift (R.-R. Avon). *Saunders-Roe S.R./A.1—still the only flying-boat fighter extant.*

the Mig-15 and the F-86 are "roughly in the same general area of technical development," which appears to be a fair assessment. Major Jabara, a Sabre pilot with six Migs to his credit, stoutly maintains that the Sabre is in every way superior, except that at heights above 35,000ft or so, the Mig is somewhat faster.

The prototype of the Mig-15 is believed to have flown on July 2nd, 1947 (the first F-86 took the air on October 1st, 1947) and it was shortly afterwards destroyed in a crash. At the outset the landing speed was unconscionably high and control was lost at the lower end of the speed range; but a change in incidence seems to have alleviated the difficulty. Later, leading-edge slots and boundary-layer fences were affixed to the wings—reducing the landing speed to about 110 m.p.h.—and the structure was stiffened. Spring tabs were installed pending perfection of a power-operated control system. Both water/methanol and afterburning were tried with the Nene-type turbojet, and a liquid-fuel rocket was fitted experimentally. As on certain American fighters, the rear portion of the fuselage was made detachable to allow access to the power plant. Initially

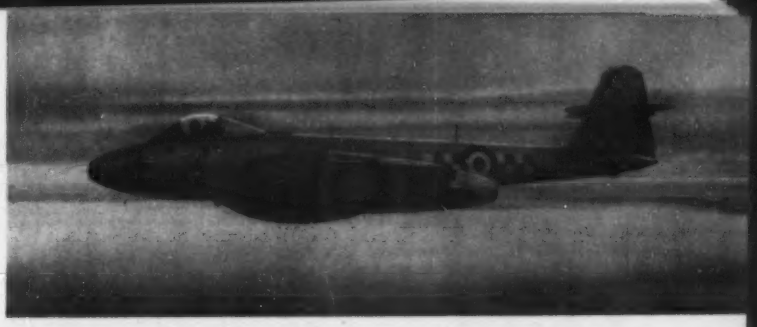
the armament is believed to have been one 37 mm and one 20 mm gun, but some, at least, of the Mig-15s now in service have three guns, which, by reason of the extreme compactness of the fuselage, have had to be housed in "blister" fairings. The initial rate of climb is probably of the order of 8,000ft/min.

In all essentials the design of the Mig-15 is nothing short of brilliant, and it must be admitted that this Russo-Germanic product has proved almost as unpleasantly formidable as did the Fokker monoplane of the First World War and the Fw 190 of the Second. Like the Fw 190, it is a model of compactness. The salvaged specimen now at Wright-Patterson Air Force Base was a godsend indeed, and the reports of American technicians, which remain confidential, have given a new impetus to the development of U.S. and British single-seaters.

A second type of Russian fighter, illustrated later, is of shoulder-wing layout; the main wheels retract into the fuselage instead of into the wing, as on the Mig. Concerning this machine there has been much conjecture and ill-founded rumour, but the fact is that little useful comment can be made, except that the design is bold in concept and, like the Mig, betrays strong German influence.

The table on this page shows the R.A.F. Vampires to be slower than the Mig-15 by some 130 m.p.h.—an unsatisfactory state of affairs when the two types are serving as the standard defensive single-seaters of their respective Services in Germany, where into the bargain the Vampires have a heavy ground-attack commitment. It

(*Continued after double page of plan-view drawings overleaf.*)



Gloster Meteor F.8 (two R-R. Derwents), with ventral tank in place.

(Below) D.H. Venom F.B.1 (Ghost) showing "combat" tanks.

OPERATIONAL FIGHTERS

Single-seaters

Service and Type	Power Plant	Max. Speed (m.p.h.)	Armament
ROYAL AIR FORCE:—			
de Havilland Vampire F.B.5 and 9	D.H. Goblin ...	531	4 × 20 mm
de Havilland Venom F.B.1 ...	D.H. Ghost ...	Res.	4 × 20 mm
Gloster Meteor F.8	2 R.-R. Derwent ...	592	4 × 20 mm
NAVAL AVIATION:—			
Hawker Sea Hawk F.1	R.-R. None ...	600 app.	4 × 20 mm
Supermarine Attacker F.1 ...	R.-R. None ...	585	4 × 20 mm
U.S. AIR FORCE:—			
North American F-86E Sabre ...	G.E. J-47	670+	6 × 0.5in
North American F-86D Sabre ...	G.E. J-47	Res.	Res.
Republic F-84E Thunderjet ...	Allison J-35 ...	600 app.	6 × 0.5in
U.S. NAVY:—			
Grumman F9F-5 Panther ...	P. & W. J-48 ...	600+	4 × 20 mm
McDonnell F2H-2 Banshee ...	2 Westinghouse J-34	600 app.	4 × 20 mm
ROYAL SWEDISH AIR FORCE:—			
Saab J-29	D.H. Ghost ...	657 app.	4 × 20 mm
SOVIET MILITARY AIR FLEET:—			
Mig-15	Lava None or Tay equivalent	660 app.	1 × 37 + 2 × 23 mm

Two-seaters

ROYAL AIR FORCE:—			
A.W. (Gloster) Meteor N.F.11 ...	2 R.-R. Derwent ...	Res.	4 × 20 mm
de Havilland Vampire N.F.10 ...	D.H. Goblin ...	537	4 × 20 mm
NAVAL AVIATION:—			
de Havilland Sea Hornet N.F.21...	2 R.-R. Merlin ...	464	4 × 20 mm
U.S. AIR FORCE:—			
Lockheed F-94	P. & W. J-48 ...	600+	Res.
Northrop F-89 Scorpion	2 Allison J-35 ...	600+	6 × 20 mm

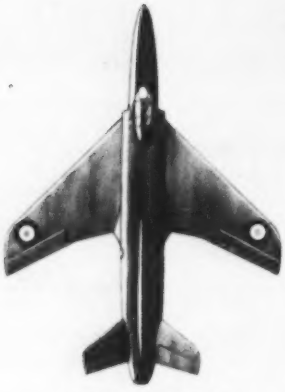
Notes: "Res." denotes "data restricted." Meteors are also standard equipment in the Air Forces of Argentina, Australia, Belgium, Denmark, Egypt and Holland. Vampires are used by Australia, Canada, New Zealand, Egypt, France, India, Italy, Norway, South Africa, Sweden, Switzerland and Venezuela. Thunderjets have been supplied to France, Belgium, Norway and Turkey. Sabres are used by Canada and are to be supplied to the R.A.F.

Hawker Hunter (Rolls-Royce Avon), adopted, like the Swift depicted opposite, as standard R.A.F. equipment. Note canopy shape, and root intakes.

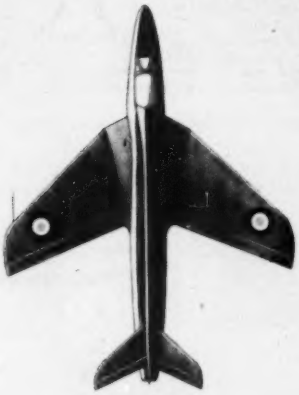
SINGLE-SEAT FIGHTERS

"Flight" Copyright Drawings

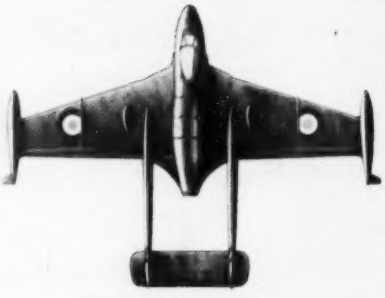
MIG-15
Nene-type turbojet
32ft 9in



SUPERMARINE SWIFT
Rolls-Royce Avon
31ft 9in



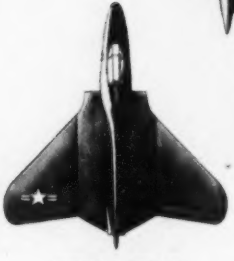
HAWKER HUNTER
Rolls-Royce Avon
33ft 8in



D.H. VENOM F.B.1
D.H. Ghost
41ft 9in

VICKERS-
SUPERMARINE 508
2 Rolls-Royce Avons
41ft

LOCKHEED XF-90
2 Westinghouse J-34s
40ft

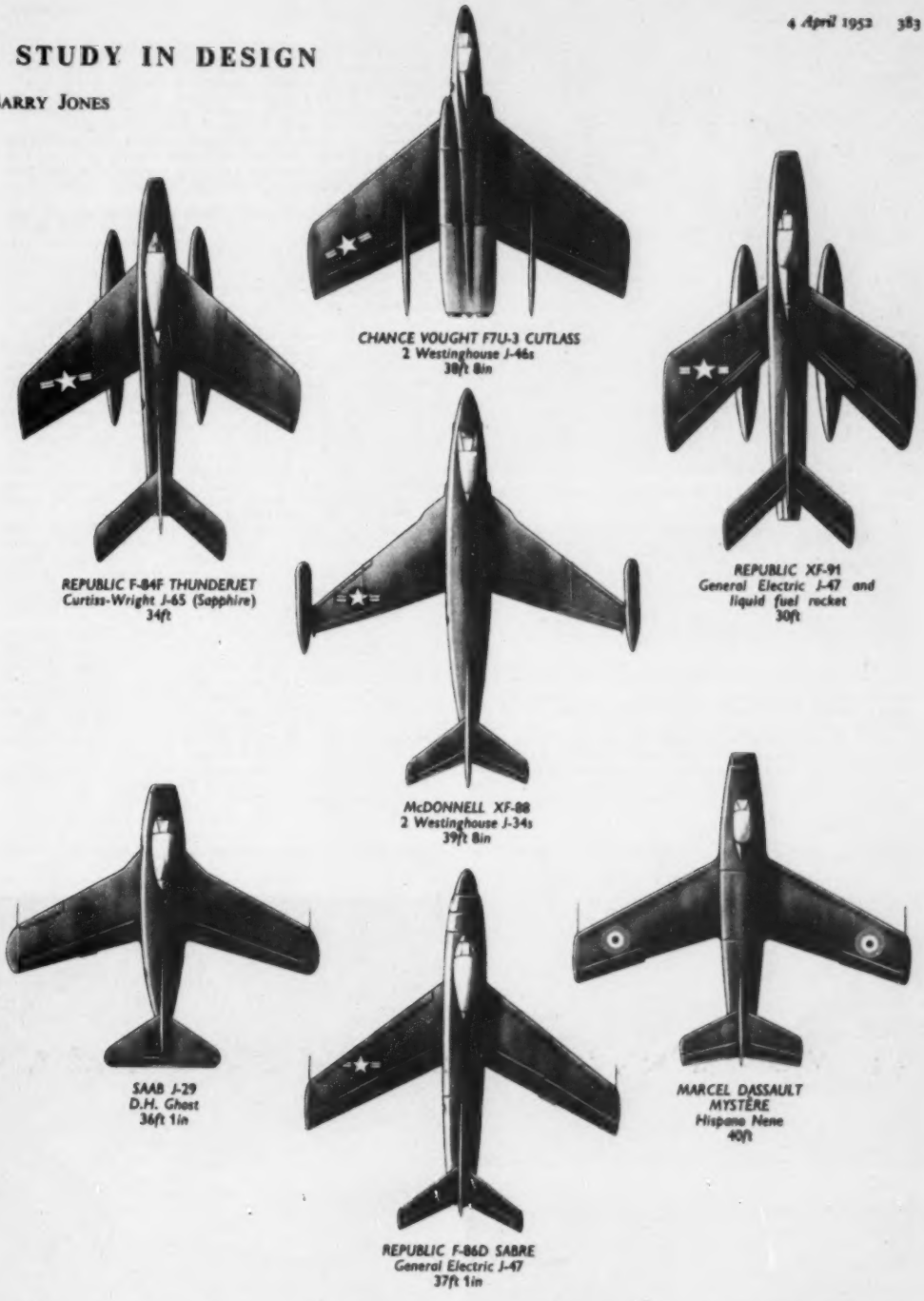


DOUGLAS XF4D-1
SKYRAY
Westinghouse J-40
24ft

THESE plan views of experimental and production-type single-seater fighters have been prepared as nearly to scale as present knowledge permits, and are valuable not only in showing relative size, wing form and area, but cockpit location, intake position and other points of concern to the designer and recognition student alike. Typical

—A STUDY IN DESIGN

by BARRY JONES



national markings are also depicted. It will be immediately apparent that nothing approaching finality has been achieved in aerodynamic design and in the disposition of the power plant. Especially remarkable are the small dimensions of the Mig-15, accounting in part for the high performance of this Russian fighter. Approximate span is quoted in each case.

North American F-86 Sabre (General Electric J-47), showing air brakes.

should, however, be borne in mind that the R.A.F. sub-types are powered with the Goblin 2, of only 3,100 lb static thrust, whereas export variants of the Vampire (Swiss Mk 6, Swedish Mk 50, and Norwegian Mk 52) have the Goblin 2 of 3,300 lb. This confers a correspondingly better performance, the maximum speed being 548 m.p.h., and R.A.F. pilots have found that the superiority of the export Vampires has been almost embarrassingly apparent in Continental exercises. Rate of climb at 30,000ft is quoted as 750ft/min for the R.A.F. version, 1,175ft/min for the export model.

All marks of Vampire retain their speed to an unusually high degree at altitude, the sea-level figure of 548 m.p.h. being reduced by only 5 m.p.h. at 20,000ft, 39 m.p.h. at 40,000ft, and 49 m.p.h. at 45,000ft. Certain comparable types of considerably higher speed—the Thunderjet, for example—are believed to experience a sharper fall-off in speed and rate of climb with altitude.

As is well known, the Vampire scores further at height in having a low wing-loading (about 40 lb/sq ft with internal fuel only) and low span-loading. Handling and other aspects of performance will be more profitably discussed later, in relation to the N.F.10 two-seater.

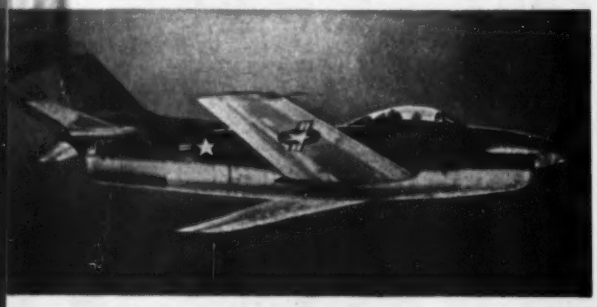
Figures having been quoted to show the improvement in performance obtained with even a 200-lb thrust increase on the Vampire, without airframe modification, it is understandable that the Venom F.B.1 now about to enter R.A.F. service should be greatly superior to all Vampire variants in speed, climb and ceiling, for the power plant is a de Havilland Ghost, nominally of 5,000 lb thrust, and capable of much greater outputs with water/methanol injection (10 per cent increase) or tailpipe reheat. A Venom with reheat was demonstrated at Farnborough last year.

The Vampire wing having been a limiting factor in high-speed flight, a new wing was developed for the Venom, having a reduced thickness/chord ratio, leading-edge sweepback (to compensate for the rearward movement of the c.g. brought about by the heavier Ghost), square tips, and—after initial trials—boundary-layer fences. Venom performance figures are withheld, but the speed must surely exceed 600 m.p.h., for the similarly powered Swedish J-29 attains at least 650 m.p.h., while the Nene-powered Argentine-built Pulqui II—now destroyed—was capable of a similar performance. Even France's S.N.C.A.S.E. Mistral, which retains the old Vampire-type wing, but, like the Venom, has some 5,000 lb of thrust, is good for 578 m.p.h.

In level-flight and diving speed, however, the Venom could hardly match the Mig-15. An official statement on performance confines itself to the "marked increase" in maximum speed, service ceiling and rate of climb as compared with the Vampire, and the "greatly increased operational ceiling," where, due to the comparatively low wing-loading and well-harmonized controls, manoeuvrability remains "positive and precise."

Certainly, there is no reason to question the Venom's qualities as a high-altitude intercepter, and at extreme heights, by virtue of its small turning circle and generally superior handling qualities, it might do well against the Mig-15. Against bombers of types comparable with the Canberra, capable of flying at heights around 50,00f., the Venom should prove a powerful antidote. As for climb, it can only be remarked that the Mistral, with its Vampire-type wing, can reach 32,800ft in about 7½ min, and that the special Ghost-powered long-span Vampire, to which the Venom is closely related, ascended to 56,500ft in 23 min 50 sec, passing 40,000ft after 7¾ min and 50,000ft after 13¼ min. At 59,446ft it was flown "hands-off" for a short time.

Radar-equipped North American F-86D and, below it, the YF-93A



Republic F-84E Thunderjet, powered with a General Electric J-47.

The Venom was the first British fighter to appear with auxiliary fuel tanks mounted at the wing-tips, in conformity with American practice on fighters with straight, or slightly swept, wings. Though these tanks can be jettisoned if need be, they are stressed for all combat manoeuvres. Fuel supply can be further augmented by under-wing tanks

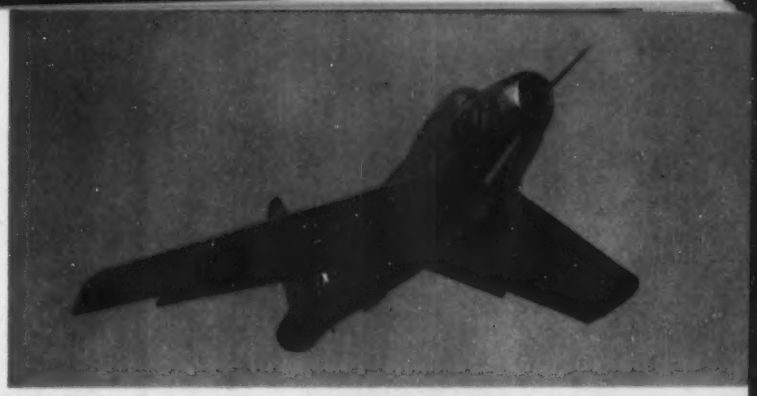
Though a swept-wing version of the Gloster Meteor (from which a Mach number approaching 0.9 seemed feasible) was at one time projected, the latest fighter development of the type to materialize—the F. Mk 8—has the short span and straight wing of its predecessor, the F.4, and differs from that variant principally in having increased tankage, and revised nose, tail and cockpit enclosure. Power units are Rolls-Royce Derwent 8s, each of 3,500 lb thrust, and the gross weight figures, with and without belly tank, are 15,675 lb and 17,250 lb respectively. The favourable thrust/weight ratio is, of course, beneficial to climb, the times for the clean condition being 1.5 min to 10,000ft; 3.6 min to 20,000ft; 6.5 min to 30,000ft; and 11.6 min to 40,000ft. With belly tank the corresponding figures are 2, 4.4, 8 and 16.1 min. Maximum level speeds at the same heights are 584 m.p.h., 575 m.p.h., 555 m.p.h., and 533 m.p.h., and the maximum permissible Mach number is 0.82. Service ceiling is 44,000ft.

Outclassed though it undoubtedly is in speed performance by the Mig-15, the Meteor 8 might compete with the Russian machine on the climb at low and medium heights (assuming no power boost in either case); and two Migs have, in fact, been claimed by R.A.A.F. Meteor pilots in Korea, though the circumstances of the victories are not known.

Apart from a dwindling number of Lockheed F-80 Shooting Stars, which hardly warrant consideration here, the standard shore-based single-seat jet fighters of the U.S.A.F. are the Republic F-84E Thunderjet and the D and E variants of the North American F-86 Sabre. In performance, the 18,000 lb Thunderjet—built and delivered in vast quantities—appears superior to the Mig-15 in range alone. Its climb is mediocre, its maximum speed little higher than the Meteor's, and though it has unusually good qualities as a ground-attack aircraft, as will later be seen, it is here considered as a fighter and as such runs a poor second to its compatriot the Sabre. The "G" variant, following the "E" in production, has provision for flight refuelling and an automatic pilot.

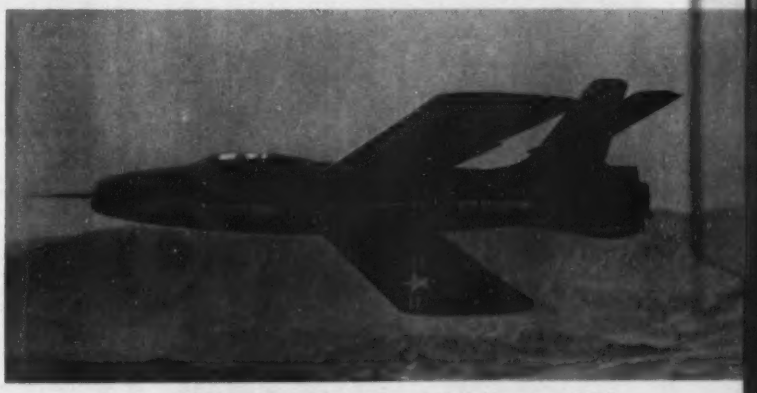
As now in service in many hundreds, the Sabre probably weighs some 13,700 lb and scores over the Thunderjet mainly by virtue of its 35 deg swept wing. Very high subsonic speeds (Mach numbers considerably over 0.9) are attained in level flight, even with external tanks, and the machine has been repeatedly dived to true Mach numbers around 1.1. Climb is probably comparable with the Meteor's, but in manoeuvring ability, particularly above 35,000ft, this excellent American fighter should prove inferior to the slower, more lightly loaded Venom, and it is doubtful if current Sabres could get to grips with 50,000ft Canberra-type bombers.

Pilots of the F-86 and other high-speed fighters habitually wear g-suits and the Americans also have their characteristic crash-helmet and face visor. The g-suit is an added comfort and allows full advantage to be taken of the Sabre's powers of manoeuvre at low and medium levels. All controls are said to be light and the "flying tail" of the F-86E is particularly helpful to the pilot in high-speed flight.

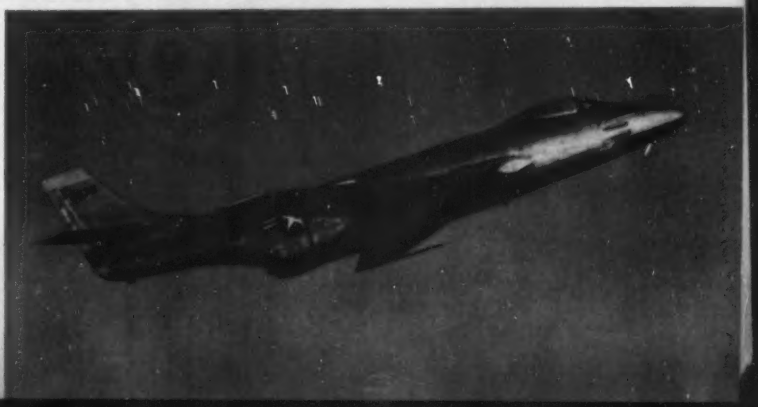


Republic F-84F, with Curtiss-Wright J-65 (licence-built Armstrong Siddeley Sapphire).

Lockheed XF-90, on which the Westinghouse J-34 turbojets have afterburners.



(Above) *Republic XF-91 interceptor.* (Below) *McDonnell XF-88 (prototype of F-101).*



In the Sabre, the stick, although it operates cable controls to the tail, is not mechanically connected to the elevators. Instead, the cables operate a hydraulic valve; this, in turn, controls the fluid supply to an irreversible jack. The jack actuates a linkage which increases the incidence of tailplane and elevator as a unit when the stick is pushed forward; but when the stick is pulled back the incidence of the whole is at first reduced and then the elevator rises. The response is as prompt and progressive as if the controls were manual and an artificial feel is, of course, incorporated. Trim is controlled from a button on the stick and operates the same circuit, but more slowly. The control valve is duplicated and a pump supplies emergency power.

The Sabre cockpit is pressurized to a differential of 2.75 lb/sq in up to 18,000ft, and 5 lb/sq in above that height, except during combat, when it is reduced to 2.75 lb/sq in. The service ceiling is generally considered to be about 47,000ft and at that height the Sabre is said to spin readily; recovery is also easy, but the loss of height is considerable. The wing slats are fully automatic and they come out in a high-speed stall as well as a normal one. The air brakes are very powerful and can be opened at any speed; they allow a maximum rate of descent of about 27,000 ft/min.

Mach troubles are heralded by a tendency for the left wing to go down, but the machine is still fully controllable. Below 25,000ft the Sabre is believed to be restricted to a Mach number of 0.95 when drop tanks are fitted—which they usually are—but "clean," or above 25,000ft, even with tanks, 1.1-1.2 is said to be possible. When the Sabre "goes supersonic" there is a nose-up change of trim and although the controls become heavier they are still effective.

The Sabre handles well at take-off and landing, but the approach and touch-down speeds are unusually high. Even so, aided by the double-drum brakes, a runway of 3,500ft can be used, although the usual length is twice that.

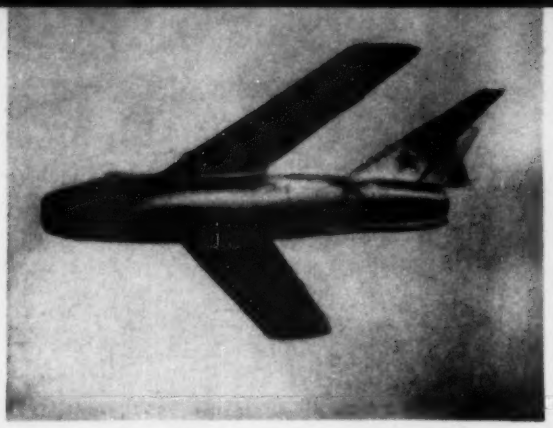
With the present J-47 turbojet the maximum rate of climb is about 7,000ft/min, attained at a very high optimum climbing speed, which arises from the high wing-loading. Though the Sabre is fast and relatively free from Mach troubles, the high wing-loading allows only a moderate ceiling and rate of climb, while manoeuvrability at altitude is restricted by the high stalling speed.

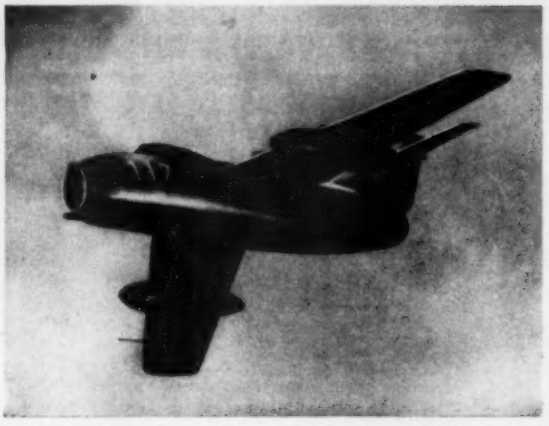
The F-86D, now in service, resembles the F-86 single-seat versions with certain important exceptions. In the extreme nose, which has been redesigned accordingly, is a radar scanner, and the internal equipment includes radar gun-laying, radar navigational aids and Sperry Zero-Reader approach equipment. To improve altitude performance, despite the increase in gross weight, the J-47-GE-17 turbojet is provided with an afterburner, housed in the enlarged rear fuselage. A Mig-15 development with a similar type of "radar" nose is reported.

Though hardly as fast as the Sabre (the declared maximum speed is approximately 657 m.p.h.), Sweden's Ghost-powered Saab J-29 is a brilliantly designed fighting machine; it is probably superior to the American fighter on the climb and in range surpasses the Mig. Over 500 are on order, and some scores have been delivered.

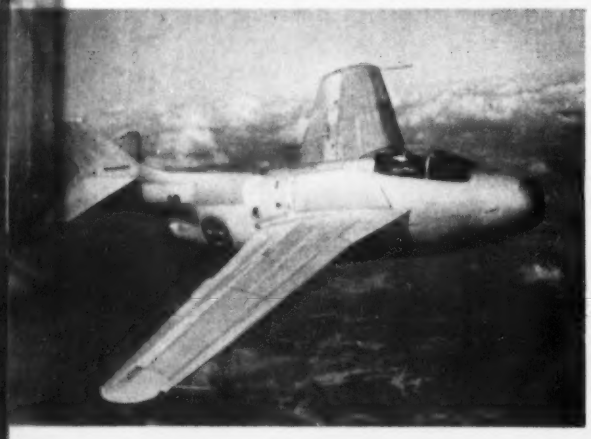
France's Marcel Dassault Ouragan is a straight-wing fighter, comparable in performance with the Thunderjet, though perhaps superior in certain aspects. First deliveries are now being made, but a swept-wing development, the Mystère, is still many months distant from operational service. This is regrettable inasmuch as this type is thought to have a performance strictly comparable with the Sabre's.

Carrier-based jet fighters now in general use are listed in the table on an earlier page, from which it will be obvious that none can rival the Mig in speed, though it may be assumed that the Grumman Panther F9F-5, with its Pratt and Whitney

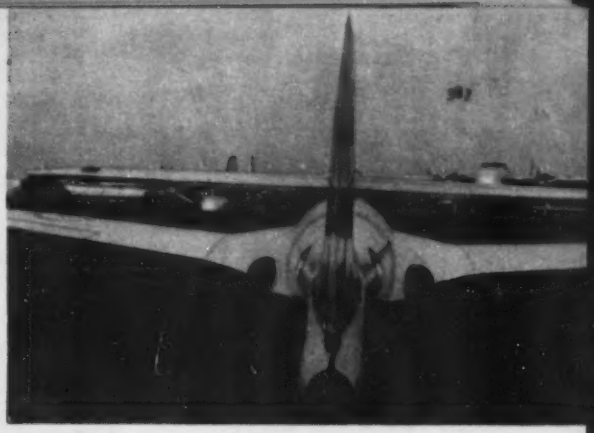




The designation of the upper of the Russian fighters shown above is not known. Below this machine is a wing-tanked Mig-15, powered with a development of the Rolls-Royce Nene centrifugal turbojet.



Depicted below are two of the best examples of Continental fighters: (Top) the Swedish Saab J-29 (de Havilland Ghost) and (below) the comparable French Marcel Dassault 452 Mystère (Hispano Nene).



(Left) The Fairey F.D.1 showing possible rocket emplacements in the tail. (Right) Hawker P.1072, with an Armstrong Siddeley Snarler rocket.

J-48-P-4 (Rolls-Royce Tay) of 6,200 lb thrust, and the twin-jet McDonnell F2H-2 Banshee give a good account of themselves on the climb. Recent news that several examples of a swept-wing Panther development—the F9F-6 Cougar—have already left the production line is the more agreeable for being unexpected. Earlier versions of the Panther, like the standard Nene-powered Hawker Sea Hawk and Supermarine Attacker, are hardly competitive with the Russian fighter, though the Sea Hawk—now going into service with Naval squadrons—is generally superior to the Attacker. Sea Hawk performance data are not available, but the Attacker, which weighs 11,750 lb "clean," or 14,055 lb with belly tank, has a top speed at sea level of 585 m.p.h. and climbs to 30,000ft in 7.1 min.

Thus it is true that the only fighters now in service which can truly be classed with the Mig on the basis of performance are the Sabre and Saab J-29. That six years after the war—by the end of which the value of sweepback was clearly apparent—these should be the only swept-wing fighters in service outside the Iron Curtain, is a sobering thought indeed.

But with present-day armament sheer speed, climb and manoeuvring power are utterly worthless in themselves: they are qualities to be valued solely as a means of bringing guns to bear, and, as already suggested, they can be offset to a certain degree by superior gun-laying equipment. According to Mr. P. J. Klass, writing in *Aviation Week*, the automatic computing gun-sight installed in the Sabre and Thunderjet was originally developed by the General Electric Company for the U.S. Navy. With this equipment the pilot must still manoeuvre his machine to keep the target continuously centred in his gun-sight, thereby feeding the target rate-of-movement data to a computor. The new computor, however, also obtains, by means of radar, information on the target's range—information which, until recently, was obtained by manual adjustment of the gun-sight itself—so that the pilot is now able to concentrate solely on tracking his target and keeping it centred in his sight.

The question of armament generally continues to be an extremely vexed one and is greatly complicated by the necessity for dealing with targets ranging from large, heavily defended bombers, to small nimble fighters. Compromise is everywhere to be seen. All single-seaters now in service with the R.A.F. and British Naval Aviation mount four 20 mm British-Hispano guns. In the Vampire, Venom, Meteor 8 and Sea Hawk these are grouped in the fuselage, while in the Attacker they are disposed two in each wing. The Vampire carries 600 rounds of ammunition, the Meteor 780, and the Attacker 624, and a gyro gun-sight is standard in each case. All U.S.A.F. single-seaters have six 0.5in Colt-Browning-type guns. The ammunition supply of the Sabre and Thunderjet has not been divulged, but the similarly gunned Lockheed F-80 has provision for 1,782 rounds. The U.S. Navy favours the British formula of four 20 mm guns, and a similar armament is standard on the Saab and Dassault fighters now in production.

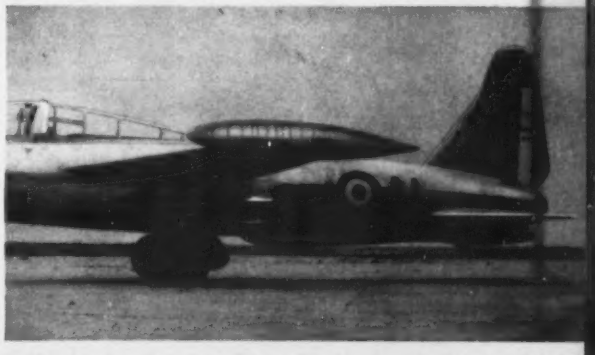
In the Korean fighting both formulae have given good results against the Mig-15, itself having one low- or medium-velocity gun of 37 mm calibre and two of 23 mm. The 6×0.5in scheme, however, has come in for sharper criticism than the 4×20 mm layout, despite the very high rate of fire—about 1,200 rounds a minute—of the M.3 "fifty calibre" armament.

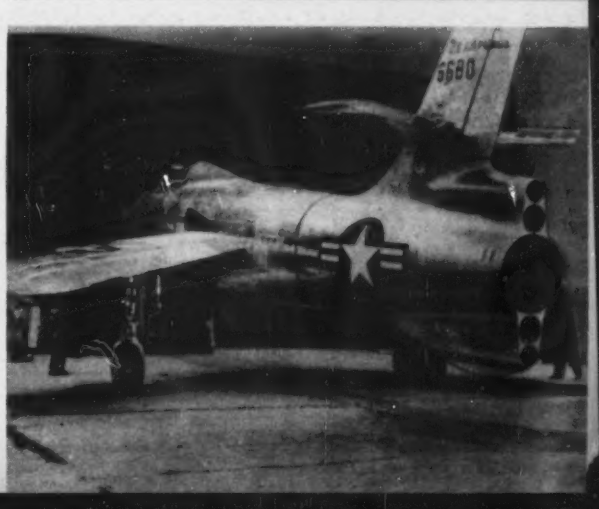
On the topic of 4in guns versus larger calibres, General Vandenberg, the U.S.A.F. Chief of Staff, has remarked that with large-bore armament the ammunition supply is strictly limited, demanding increased accuracy, which is difficult to obtain at high speeds. To date, he said, the 0.5in machine gun had proved superior to the cannon of the Mig-15.

It would appear that forthcoming U.S.A.F. single-seaters will have four 20 mm guns, and these they will certainly need against thick-skinned, heavily armoured bombers capable of outranging them with their own defensive weapons—this notwithstanding reports that Thunderjets using electronic computor sights have repeatedly hit Migs at ranges of up to 2,000 yards (the normal effective range is reckoned as 750 yd).

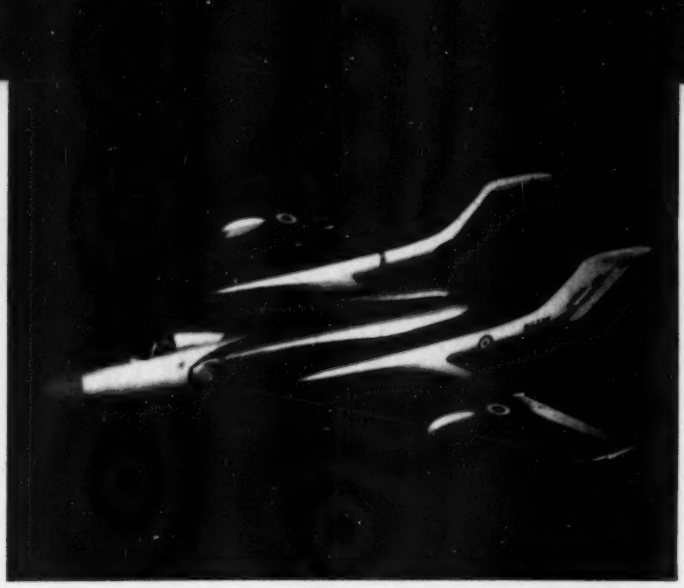
The first standardized installation of air-to-air rocket projectiles is that on the F-86D, which has provision for 24 Mighty Mouse folding-fin, solid-propellant R.P.s of 2.75in calibre, originally developed by the U.S. Navy. The "D" has the further distinction of carrying search radar, and is an interesting link between the single-seaters just reviewed and the two-seater machines more lavishly equipped with radar for night and/or bad weather fighting and now to be examined. Here it may be remarked that radar in a modern intercepter is desirable not only for the location of

Below are (uppermost) the S.O. 6026, with a rocket beneath the tail-pipe of the Nene; and a close-up view of the Republic XF-91.





FIGHTERS

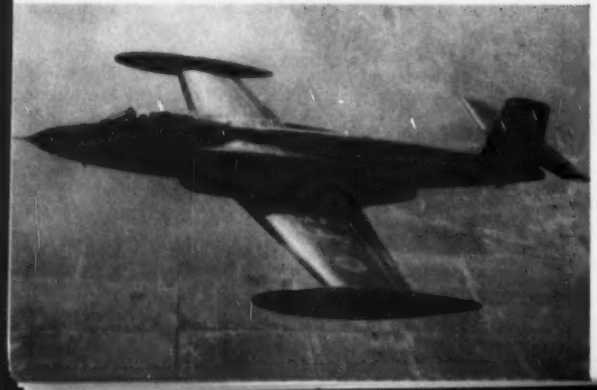


(Right) The D.H.110 experimental night and all-weather fighter (two Rolls-Royce Avons), soon to be evaluated alongside the delta-wing Gloster G.A.5 (two Armstrong Siddeley Sapphires) shown banking below.

enemy aircraft at night or in bad weather, but in the conditions prevailing at very great heights, where visual spotting and ranging are matters of the utmost difficulty.

On the score of performance the Armstrong Whitworth (Gloster) Meteor N.F.11 and de Havilland Vampire N.F.10 approximate to their respective trainer versions, but actual figures can be quoted only for the Vampire—the sole machine of its class for which such publicity has been allowed.

The crew of the Vampire are seated side by side and have A.I. radar and navigational aids, but notwithstanding the greater bulk of the nacelle, as compared with the single-seater, the maximum speed at the higher altitudes is greater, due to the better fineness ratio. The top speed at sea level is 539 m.p.h. and at 40,000ft 519 m.p.h. Patrol duration, with allowance for take-off, climb, 10 minutes' combat and descent, is 2.7 hr at 30,000ft with drop tanks, and 1.45 hr without them. With the full tankage a still-air range of 1,060 nautical miles is attainable at 30,000ft, or 540 nautical miles at sea level. The aircraft reaches its operational ceiling of 40,000ft in 16.3 min in the clean condition, but the



(Left) A.W. (Gloster) Meteor N.F.11. (Lower left) Avro Canada CF-100 (R.-R. Avons or Avro Canada Orendas). (Below, upper) D.H. Vampire N.F.10, and the Ghost-powered D.H. Venom N.F.2, ordered for the R.A.F.

drop tanks reduce the operational ceiling to 34,000ft and increase the time to this height of 17.5 min. At a Mach number of 0.7, at 40,000ft, the radius of steady turn is 1.95 nautical miles, and at the same speed and height a minimum radius of turn of 0.95 nautical miles can be achieved.

The figures for turning radius are of particular interest, and though comparative data for other types are not available, a steady-turn radius of 3-4 miles would not seem an excessive estimate for faster machines with a higher wing loading.

The Vampire retains the standard 4×20 mm gun armament, as does the Meteor N.F.11; in the Meteor, however, installation of radar in the nose has necessitated the transfer of the guns from the fuselage to the wings, outboard of the nacelles. In theory at least this location is prejudicial to accuracy and to aircraft stability with a gun or guns inoperative, but in practice these objections do not appear to be serious. The crew of two are seated in tandem, and in the latest version the external wing tanks have been transferred to the tips, in conformity with generally accepted practice. A ventral tank is carried as standard equipment.

The U.S.A.F. has standardized on the Lockheed F-94 and the Northrop F-89 Scorpion as its two-seat night and all-weather fighters, and the U.S. Navy's counterpart is the Douglas F3D Skyknight. Closely related, like the British machines described, to a two-seater trainer development of a basic single-seater design, the F-94 has been produced in several variants, all of which have an afterburner to improve climb at the increased all-up weight. The latest version (production-type F-94C) has thinner wings than had previous aircraft of the series, an extended nose, swept-back tailplane and redesigned vertical surfaces. Both pilot and radio operator have radar, though the latter's is considerably more elaborate. The four-gun armament can be supplemented by 24 "Mighty Mice."

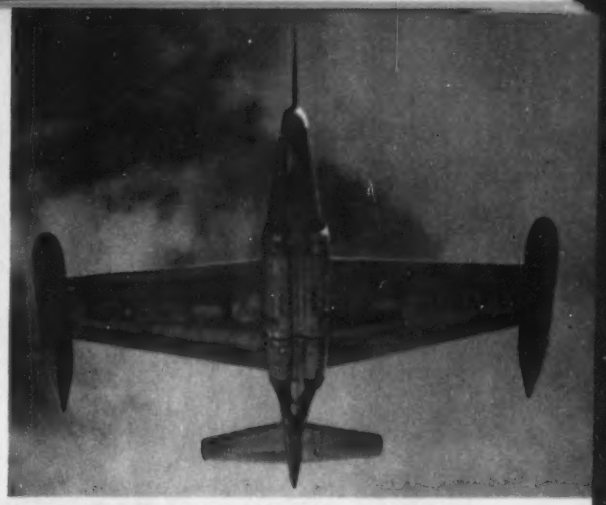
Weighing, probably, over 16,000 lb, the F-94C may have a wing loading of at least 65 lb/sq ft, so that its manoeuvring powers at altitude should be much inferior to those of the Vampire N.F.10. Equipment is thought to include fire-control radar, Sperry Zero Reader, and a Lear F-5 lightweight automatic pilot.

Technically of greater interest in that it was designed specifically for its duties, and not adapted from an established design, the Northrop Scorpion has likewise passed through various progressive stages of development. The F-89A, as at present in service, has two Allison J-35-A-21 turbojets, of 5,200 lb, with Solar afterburning equipment. Six 20 mm guns (combined rate of fire 4,800 r.p.m.), with a generous ammunition supply, are grouped in the nose. The Scorpion is a massive machine, measuring 55ft in span and weighing well over 30,000 lb, the maximum overload weight being 40,000 lb or more. Pilot and radar operator are seated in tandem. Equipment includes a radar scanner and modulator unit in the nose, radar servo gear, radar indicator panels, radar gyros, I.F.F., radio compass, radar gun-laying computor, Sperry Zero Reader, special anti-icing measures for the wings, rail and air intakes, and (shades of Jutland!) a power-operated ammunition hoist. The maximum speed is over 600 m.p.h. and is made possible by a very thin wing (8½ per cent at the root), claimed to give the same drag alleviation as would a sweep-back of 35 deg.

Whereas the sub-type A has provision for rocket projectiles beneath the wings, the new F-89D carries this type of armament in massive tank-like housings at the wing-tips. The rockets and guns are electronically aimed and automatically triggered.

The straight-winged, carrier-borne Douglas Skyknight (4×20 mm guns) is a smaller machine than the Scorpion but, in its current form at least, appears somewhat underpowered. A point of special interest is the system of cockpit lighting, designed to prevent glare and assure constant illumination of all necessary instruments, the gradations of which are etched in transparent Lucite and are lit up from behind by a red light. Another unusual feature is the ventral "bale-out 'chute" for the crew of two, the usual ejector seats being absent.

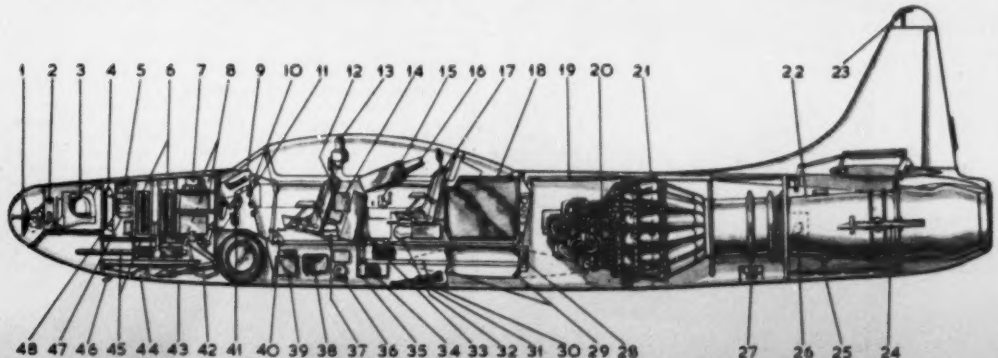
It would be a little surprising if Russia did not have at least

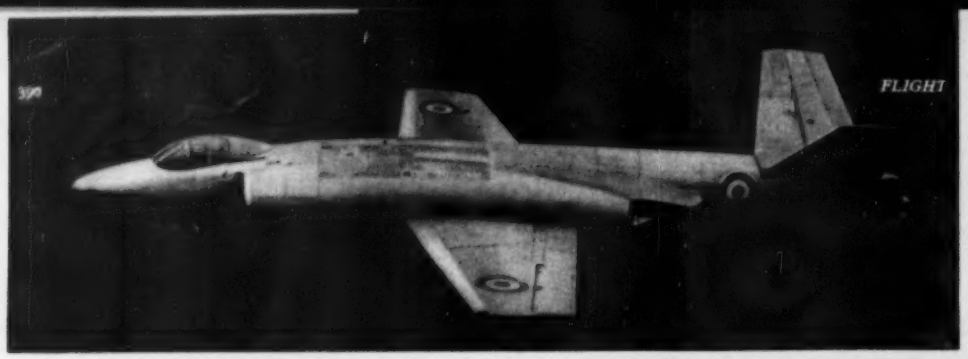


Northrop F-89D Scorpion (two Allison J-35) with wing-tip rocket housings.

Early Lockheed F-94, with Pratt and Whitney J-48 (Rolls-Royce Tay).
(Below, drawing and key) Internal arrangement of the F-94C.

1. Plastic nose.
2. Radar aerial.
3. Radar modulator.
4. Oxygen bottle.
5. Radar-range servo gearbox.
6. Ammunition boxes (4).
7. Position-light flasher.
8. Radio receivers.
9. Gun sight.
10. Pilot's radar.
11. Instrument panel.
12. Pilot's seat.
13. Radio-compass loop aerial.
14. Radar-indicator power supply.
15. Radar manual control.
16. Operator's radar.
17. Radar operator's seat.
18. Fuselage fuel-tank.
19. Elevator control-rod.
20. Turbojet.
21. Fuselage after-section.
22. Afterburner.
23. Radio aerial.
24. Afterburner track.
25. Afterburner-eyelid actuator.
26. Elevator-tab motor.
27. Gyrosyn compass flux-valve.
28. Aileron booster unit.
29. Wing spars.
30. Dive brakes.
31. Turbine and cooler unit.
32. Aileron torque-tube.
33. Cabin air mixing-valve.
34. Intercphone amplifier.
35. D-2 inverter.
36. Radar inverter.
37. Radar vertical gyro.
38. Censored radar.
39. Batteries.
40. Aileron-elevator control assembly
41. Rudder pedals.
42. Nosewheel landing-gear.
43. Fuselage nose-section.
44. Case-ejection door.
45. Machine guns (4).
46. Air-speed pitot.
47. Gun-sight computer.
48. Gun-sight amplifier servo



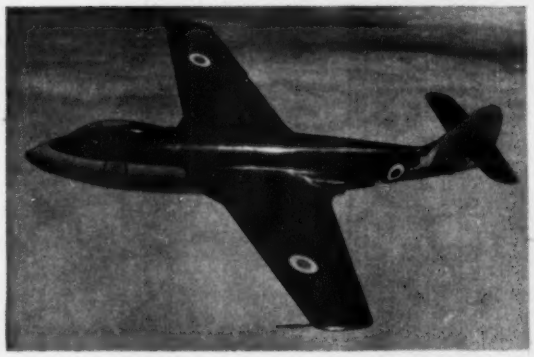


one type of jet-propelled all-weather fighter in service, especially so as the Germans were operating radar-equipped two-seat Me 262s at the war's end and had designs for extremely advanced machines of the same class; but in the absence of definite information on this point further speculation is not warranted.

The motley array of today's front-line fighters has now passed under review. In the main, the British and American machines appear barely adequate for current—not to mention future—air-fighting requirements; moreover, while the new prototypes display some advanced thinking, it could be wished that a clearer picture of future requirements were reflected in their design. Among these prototypes two British single-seaters—the Hawker Hunter and Vickers-Supermarine Swift—are in the forefront, though neither is of unorthodox configuration.

The Hunter is primarily an intercepter and, at last year's S.B.A.C. Display, demonstrated a sea-level speed approaching 700 m.p.h. and superb handling qualities. It was then powered with a Rolls-Royce Avon of unspecified output, and apparently carried no armament. The wing is only moderately swept, but there is every reason to suppose that a greater angle of sweepback could be incorporated, and that a turbojet of 8,000 lb or greater thrust, with the added benefit of afterburning, might be installed. If—as commonly believed—the Hunter is designed for an armament of four high-velocity 30 mm guns, it will evidently need a thrust of the order indicated if it is to achieve the rate of climb which will be demanded in the years immediately ahead.

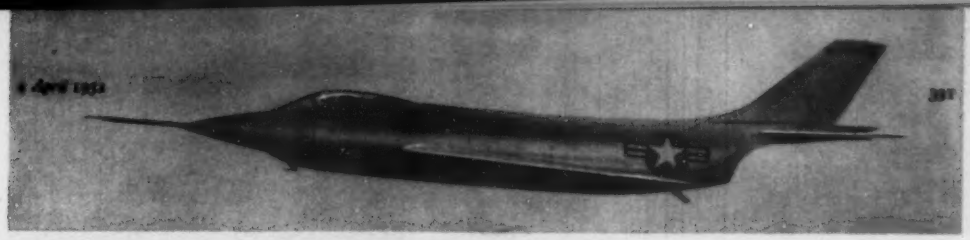
A counterpart of this excellent Hawker fighter, the Swift is likewise Avon-powered, but the prototype appears to have more sharply swept horizontal surfaces. This fighter is a development of the Types 510 and 535, in which the four 20 mm guns were carried in the wings, and it will be interesting to see what augmentation and concentration of armament has been effected in the production version.



British naval fighters: (top to bottom) Vickers-Supermarine 508 (two Avons), D.H. Sea Vampire N.F.20 (Ghost), Hawker Sea Hawk (Nene), Hawker P.1052 (Nene) and Vickers-Supermarine Attacker (Nene).

The carrier-borne Supermarine 508 has a "butterfly" tail and a straight wing of very thin section, with variable-camber leading-edge flaps, apparently interconnected with the trailing-edge flaps. This machine is primarily a naval intercepter, designed to have an extremely high rate of climb, to which end two Rolls-Royce Avon engines are installed. In the absence of figures for the 508, the climb performance of an experimental Meteor with two Armstrong Siddeley Sapphires is valuable as an indication of possibilities. This machine climbed to 9,843ft in 1 min 16 sec (rate of climb, 7,760ft/min); to 19,686ft in 1 min 50 sec (10,740ft/min); to 29,529ft in 2 min 25 sec (12,215ft/min); and to 39,372ft in 3 min 7 sec (12,630ft/min), a performance which is the more remarkable in having been achieved from a standing start.

Of existing American prototypes the Lockheed XF-90, Republic XF-91, McDonnell XF-88 Voodoo, and Chance Vought XF7U-1 Cutlass were all referred to in the preceding review of this series, but it is not uninteresting to follow the fortunes of these machines in the meantime. The XF-90 and XF-88, like the North American YF-93 Sabre development, were intended as "penetration" fighters and, excepting the YF-93, which has a Pratt and Whitney-built Tay, are powered with two Westinghouse

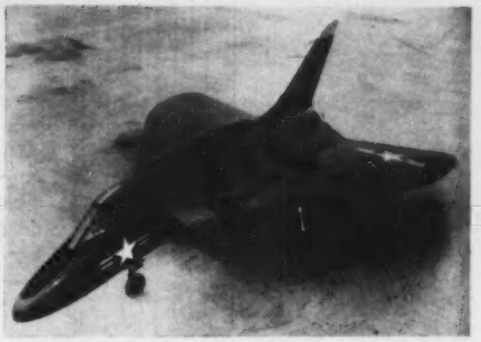


J-34 axials, the XF-88 having McDonnell short afterburners into the bargain. Much was expected of these heavy long-range machines (the XF-90 weighs something like 25,000 lb), but the months and years passed with no serious suggestion of a production order, though it has been apparent for some time that the Voodoo was considered the best of the bunch—considered, that is, as an escort fighter-cum-ground-attack machine, sponsored jointly by the U.S.A.F. and the Army. According to a recent report, the type has at long last been—as the Americans have it—"procured," under the designation F-101.

Precisely what factors have militated against more immediate acceptance of one or more of these penetration fighters is not known, but it would appear that the high wing-loadings involved would be severely prejudicial to manœuvrability at height, and that in any case the thrust available from the two Westinghouse units—even with afterburning—has proved barely adequate. To achieve supersonic speed at sea level it is said the F-90 would require 26,000 lb of thrust.

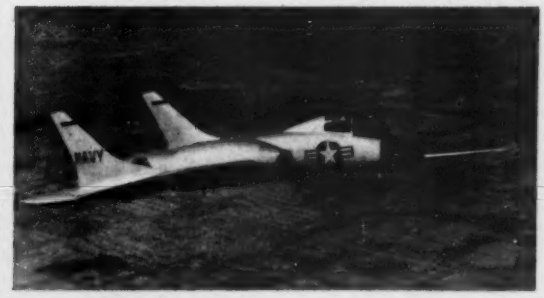
For the reported production version of the Voodoo Westinghouse J-34-WE-22 units, of 3,600 lb thrust without afterburning, have been named. Armament is given as six 20 mm guns (though four 30 mm weapons might be substituted), and, though the range with built-in tankage should be nearly 2,000 miles, provision will be made for flight refuelling.

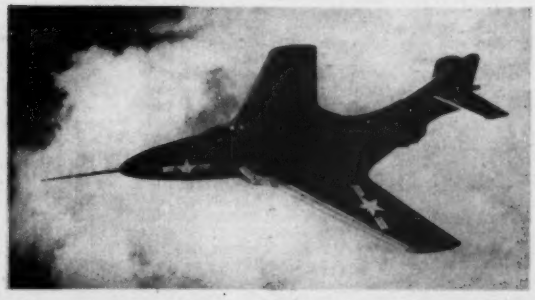
The Republic XF-91 is far removed in its purpose from these long-ranging machines, having been designed solely for interception, using both turbojet-cum-afterburner plus rocket power. With its multiple rocket installation, variable-incidence, inverse-taper wings, and tandem-wheel main undercarriage assemblies, it is a machine of more than usual interest, though there has been no hint of quantity production. Whatever its own future, however, the XF-91 stands as a pointer to the pure- or part-rocket interceptors which are now being closely investigated by technical and planning staffs. It appears that trials have been held up by delays in delivery of rocket units.



The McDonnell F3H-1 Demon heads the American naval fighters on this page. Adjacent to it (above) is the Douglas XF4D-1 Skyray.

Below are the Chance Vought XF7U-3 Cutlass (two Westinghouse J-46), Grumman F9F-6 Cougar (P. and W. J-48), and McDonnell F2H-2 Banshee (two Westinghouse J-34s). The Cutlass and Cougar are entering service.

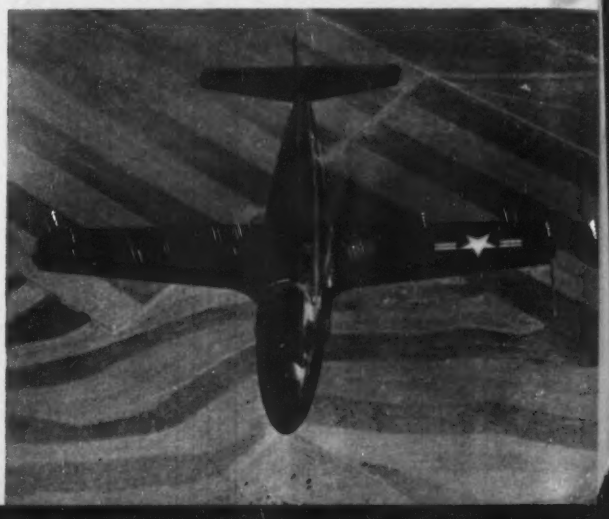


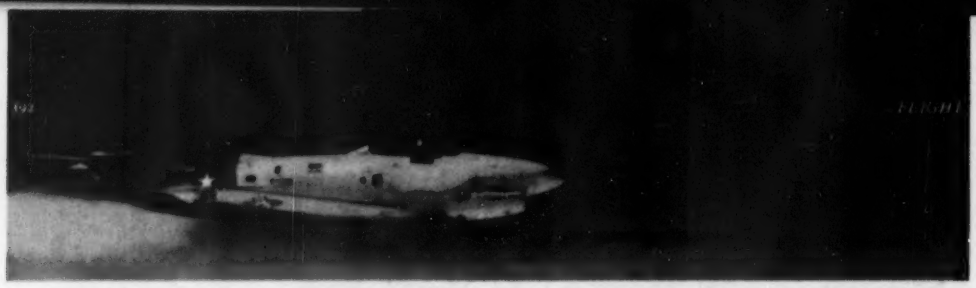


It is not inappropriate to remark here that Britain's delta-wing Fairey F.D.1, officially described as a research aircraft, has a group of fairings disposed round its jet-pipe suggestive of provision for auxiliary rocket power; and in the cautiously worded, officially "vetted" information release concerning this aircraft appears the admission that it was designed for "important research work with revolutionary possibilities in the design and operation of fighter aircraft." Experimental rocket installations have been made in the Hawker P.1072 (Armstrong Siddeley Snarler) and in a development of the French Sud-Ouest Espadon.

In the absence of specific data for a rocket fighter of the "target-defence" or "alarm" type we are obliged to Mr. Howard R. Moles, chief engineer to Reaction Motors, Inc., for a peculiarly well-founded hypothesis. The fighter envisaged would ascend from a special launching ramp operating under the machine's own power. The gear for launching would remain behind and the aircraft would be equipped with fixed or retractable skids for landing. Alternatively, it could alight on any relatively smooth

Douglas F3D Skyknight (two Westinghouse J-34s) as now in service. As in the Sea Venom, the pilot and radar operator are seated side by side.





An F-86D Sabre "all-weather intercepter" discharges a salvo of 2.75in Mighty Mouse anti-aircraft rockets, of which it carries 24.

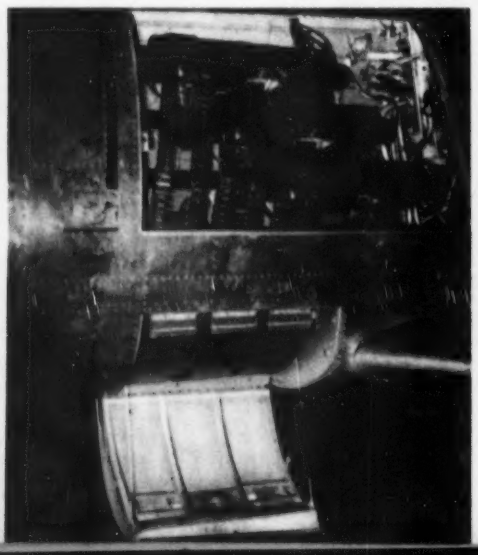
water. Missiles, or "warheads," estimated to total about 1,000 lb, would be stowed at the wing-tips. A small independent propellant charge would be carried with each to give it a velocity slightly in excess of that of the aircraft. Estimated characteristics of the intercepter are: Gross weight, 13,000 lb; landing weight, 3,500 lb; wing area, 100 sq ft; wing span, 25ft; fuselage length, 30ft; propellants, 8,000 lb; max. speed, in excess of 2,000 m.p.h.; max. rate of climb, in excess of 50,000ft/min; ceiling, above 200,000ft; range, 140 miles.

In such a machine of the type a radar scanner would be located in the nose, and directly behind this would be the pilot. The entire nose could be detachable as a capsule for lowering by parachute and behind would be a section for radio and communication equipment; then, occupying the major portion of the fuselage compartment, would come the propellant tanks. The aft end would be occupied by the power plant, consisting of two cylinders with a total thrust of 26,000 lb. One cylinder would be a 5,000 lb thrust unit; the other of 21,000 lb thrust.

Once the position of the approaching enemy had been established, the launching ramp, with the intercepter on it, would be set to give the direction for interception. The small cylinder would be started, to be followed, when a stable condition had been reached, by the large cylinder. This would launch the machine with an acceleration of about 2g, and as the fuel was consumed in flight the acceleration would increase but would be limited to a maximum of 6g. Various methods of climb would be possible. The large cylinder could be turned off and on, or it could be operated continuously, depending upon the desired point of interception.

Notwithstanding the promise shown by rockets the automatically controlled, pilot-monitored, 60,000ft intercepter which the U.S.A.F. hopes to have by the end of 1954 will be turbojet-powered. Tenders by Convair, Lockheed and Republic were invited and a contract has recently been awarded for a delta-wing Convair designated F-102; the electronic guiding equipment has been ordered from Hughes Aircraft. One internally stowed missile is said to be the armament.

Three of the six 0.5in Colt-Browning guns of a North American F-86E.



Having taken account of such futuristic possibilities, we resume our contemplation of existing prototypes, and it will be seen that these themselves are not all of orthodox layout. The U.S. Navy's Chance Vought Cutlass, for example, is tailless. Having undergone a somewhat turbulent period of development, the type is well advanced in production under the designation F7U-3, and from all accounts is not only fast, but, like other U.S. Navy fighters, has more than average manœuvring qualities at high altitude.

The courage shown by the U.S. Navy in sponsoring the development of the tailless Cutlass is equalled by that displayed in its sponsorship of the Douglas Skyray, a delta-wing machine powered by a single Westinghouse J-40 turbojet (7,500 lb thrust) and intended solely for interception after a catapult launch from a carrier. It has been suggested that short-endurance intercepters of the Skyray class might be powered with short-life turbojets of very high output—upwards of 12,000 lb thrust, with afterburning—permitting supersonic speeds to be attained in level flight.

More orthodox in aerodynamic design is the swept-wing McDonnell Demon, likewise with Westinghouse J-40, but concerning which little is known other than can be learned from the photograph on the preceding page. The Demon, like the F-86E, has an "all-flying" tail and is already the subject of a production order; but evidently it could not be available in quantity for many months to come. In the meantime, the U.S. Navy is acquiring quantities of a folding-wing "navalized" version of the Sabre F-86E (FJ-2 Fury) and of Grumman Cougars, and these may be the first swept-wing deck-landing fighters to pass into squadron service. Like the Australian-built, Avon-powered Sabres, the FJ-2 has four 20 mm guns.

It is a fact worth noting that the latest U.S.A.F. single-seater prototype (and one which gives high promise) is a swept-wing development of the Thunderjet—a machine which, in its common straight-wing form, is of undistinguished performance, as already intimated. Designated F-84F and powered with an Armstrong Siddeley Sapphire (Curtiss Wright licence), the production version of the "swept Thunderjet" is credited with a fine all-round showing and, when figures are available, they should make a most interesting comparison with those for the F-100 development of the Sabre, having 45 deg of sweepback instead of 35, as formerly, and powered by a Pratt and Whitney J-57.

The tally of multi-seat all-weather fighter prototypes is shorter than that of single-seaters, and claim to first consideration must be allowed to new British machines, the D.H.110 and Gloster G.A.5. Described officially as multi-purpose fighters, these are evidently intended for high subsonic speeds and long ranges. Armament is heavy and airborne interception and navigational equipment elaborate.

Structurally and aerodynamically these two impressive fighters are as dissimilar as are their forebears, the Meteor and Vampire, the Gloster having a delta wing and a short fuselage carrying a very large fin and delta-form tailplane, whereas the D.H. designers have adhered to their traditional twin-boom layout. The only photographs released for publication indicate generous wing area in both cases, and if, as seems possible, the Gloster design staff have taken advantage of the tail unit in order to fit flaps on the wing, the G.A.5 might prove to have take-off and landing speeds lower even than those of the flapless, though thoroughly docile, little Avro 707 delta research aircraft—a factor of considerable importance on night operations. Performance and range should be unusually good in both cases; indeed, these two British machines must perforce display some quite exceptional qualities if they are to surpass by any substantial margin the Avro Canada CF-100, powered in its production form by two Orenda turbojets and unofficially reported to be armed with four 30 mm guns. It may be remarked that the power plant installation of both the G.A.5 and D.H.110 appears suitable for the incorporation of afterburners.

Though having less than half the thrust of the G.A.5, D.H.110 and CF-100, the de Havilland Venom N.F.2 and Sea Venom N.F.20 (ordered for the R.A.F. and Royal Navy respectively) are likely to carry a somewhat less elaborate radar installation and a lighter armament load; even so, their demonstrated performance is impressive. The Venom night fighter has been adopted by

France also, though that nation is building domestically an all-weather fighter of comparable type, but probably faster. Designated M.D.453 Harmattan, this is a development of the Mystère single-seater, with side intakes to permit nose-mounted radar.

The armament of most of the prototypes named is more or less secret, but it can be said with a fair degree of certainty that the 4 x 30 mm gun formula will become common, supplemented by guided missiles of various forms and weights. For the missiles, internal stowage would appear to be difficult on all existing types of fighter, and it will be necessary to carry them, drop-tank style, either beneath the wings or at the tips.

Tests of the Saunders-Roe S.R./A.1—the only jet fighter flying-boat ever to materialize—are now concluded, and no immediate production order for a development of the type seems likely. But the theme is not dead, and Mr. H. Knowler, designer of the S.R./A.1, has described a proposed fighter boat, with retractable hydro-skis, which, though capable of taking off from water, is no longer a flying-boat in configuration. Mr. Ernest G. Stout, of Convair, has discussed the possibility of a delta-wing fighter of blended-hull configuration, the design having been initiated after tests with the 60-deg delta-wing XF-92A research aircraft. These tests are claimed to have shown, incidentally, that such a wing form was "definitely superior to conventional swept-back configurations from the standpoint of drag, stability and control, particularly at low, subsonic speeds in the critical regions of take-off and landing." A heavy-fighter flying-boat, carrying pilot and radar operator and capable of Mach 0.9, has been mooted.

Armourers at work on a de Havilland Vampire F.B.5. Four 20 mm guns form the armament of all standard marks of the Vampire and Venom.

For carrier-borne aircraft (certain of which might, incidentally, be of flying-boat type) catapult take-off will become normal, and it is a matter for congratulation that the most effective catapult yet developed is the new British steam-driven type now under test in America. A parallel development is the flexible deck, tests of which, as a few fortunate visitors to last year's S.B.A.C. Display will bear witness, are still under way. Ramp or catapult-launch may become conventional for land-based intercepters, when these machines enter a phase of development which may eventually identify them with air-to-air pilotless missiles.

Sequences in an operation by U.S.N. Grumman Panthers: (above, left) the tip tanks are refuelled on the deck; (below, left) 20 mm ammunition is taken aboard: (lower right) a pilot takes his seat (note the impedimenta about his person); (above right) a Panther ready on the catapult.

The P.V. Meteor ground-attack fighter is seen (left) with 24 rocket projectiles. (Right) A Vampire F.B.5 discharges R.P.s on a practice run.

GROUND ATTACK

AS already intimated, most types of fighter now in use are adaptable for ground attack, and it is these which are chiefly employed for the support of ground forces. Russia continues to operate squadrons of heavily armoured Il-10 two-seaters, of poor performance but designed from the outset for low-flying attacks in face of ground opposition, and the twin-engined Douglas B-26 (counterpart of the R.A.F.'s Bristol Brigand and the Russian Tu-2) has given good service in Korea. A photograph of a representative B-26 ground-attack load is reproduced here, as this shows the various weapons to good advantage; but later jet-propelled "tactical" bombers, e.g., English Electric Canberra B.2 and Martin XB-51, will be considered under the heading "Bombers," though the B-51 was designed to carry a very heavy fixed-gun armament in addition to its bomb load. It may be noted in this connection that one very senior Air Commander in Korea is on record as asserting that "medium bombers," using new sights and bombing techniques, have well-nigh outmoded fighter/bombers for attacks on many types of tactical target; his views, however, are not universally shared.

The so-called "intruder" class (wherein the Mosquito was pre-eminent during the war) is being revived by the U.S.A.F. in the form of the Martin B-57A variant of the Canberra, and this, from all accounts, will be a hybrid ground-attack/light-bomber/heavy-fighter machine, intended to create as much havoc and confusion as possible during the hours of darkness, with guns and light bombs, against air and ground targets. Note that it bears a "B" (bomber) designation, the "attack" category having been abolished by the U.S.A.F. some years ago.

The principal weapons of ground-attack aircraft now in being are guns, rocket projectiles, bombs and napalm tanks. As supplied to the R.A.F., the D.H. Vampire F.B.5—officially classed as a fighter/bomber—has provision for eight 60 lb R.P.s and two 500 lb bombs; but the bomb load can be carried only by sacrificing the auxiliary fuel tanks. This disability has been overcome in the Venom, which, with its tip-tanks in place, carries an external armament load heavier than that of the Vampire.

The private-venture ground-attack development of the Gloster Meteor 8 likewise has wing-tip tanks, not only because these are aerodynamically more efficient than the under-wing variety, but to ensure that the carriage of external armament stores shall not be prejudiced. Under each wing a 1,000 lb bomb is carried on a specially developed pylon-type mounting, embodied in which is the necessary lifting tackle, and two additional 1,000-pounders can be taken under the fuselage. Alternative to this bomb load a

Dense smoke-trails mark the passage of Bofors rockets from a Saab J-21R (above). (Below) A Republic F-84E delivers part of its rocket load.

A piston-engined Hellcat of the U.S. Navy discharging a 1,200-lb Tiny Tim rocket at the Naval Ordnance Test Station, Inyokern, California.

A Thunderjet demonstrates low-level "skip" bombing. It has just released a 100-lb bomb against the target seen on the left.

maximum of 24 rocket projectiles, on double-tier mountings, can be stowed in the same positions. Interchangeable with the fuselage 180-gal drop tank is a large fairing which can house two guns of 20 or 30 mm calibre. To allow operation from forward airfields provision has been made in this aircraft for the fitting of six 1,500 lb six-second take-off rockets—four, mounted in pairs, on each side of the fuselage, and two on the under side. For use with suitable ground-arrester gear it is possible to provide a hook.

The most widely used jet-propelled ground-attack aircraft is the Republic F-84, the current "E" variant of which has provision for 32 5in rockets, or 16 of these weapons in addition to two of the massive 1,200 lb "Tiny Tims." Alternatives to the "Tiny Tims" are two 1,000 lb bombs, napalm tanks, incendiary bombs, or 100 lb or 500 lb fragmentation clusters. The swept-wing development of the Thunderjet displays a similar propensity for handling heavy and bulky combinations of external stores, a representative load being two 1,000 lb bombs and 18 5in rockets, these latter being mounted far outboard, almost at the wing-tips, in triple-tier stowage. It is stated by the Republic Aircraft Corporation that in Korea F-84Es have operated with full armament loads and without rocket assistance from runways of less than 6,000ft, whereas the U.S.A.F. had expected 9,500ft and Jato would be required.

The primary "punching" weapon of the modern ground-attack aircraft is, as will have been gathered, the rocket projectile, but in Sweden at least guns of unusually heavy calibre are sometimes mounted to complement the rockets: thus, a very efficient Bofors gun, of 57 mm bore and having a rate of fire of 180 r.p.m., is installed in the Saab T.18B twin-engined attack bomber. Another Swedish development is an external "tank" housing a number of fixed guns; but this is no novelty.

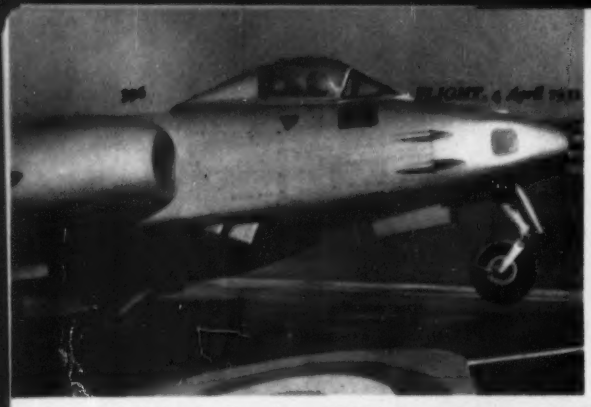
There is a body of thought that for certain types of tactical operation light aircraft of private-owner class, equipped with guns and R.P.s, could play a valuable rôle, and that, due to their manœuvrability at relatively low speeds and very low levels, they might be well-nigh immune to air action. They must, however, remain very vulnerable to ground fire. Examples are the Fletcher FD-25 Defender (advertised as having "the effect of a heavy tank at one-twentieth the cost") and the Temco Buckaroo, capable of carrying ten 2.75 rockets and two .30in guns. This machine is capable of flying at 125 m.p.h. for strafing and target-marking runs, or—for its alternative application of liaison work—at little more than 50 m.p.h.

Certainly, piston-engined and turboprop ground-attack machines still command attention, and the carrier-borne turboprop Douglas Skyshark is claimed to carry four times the bomb load per gallon as pure-jet types in use, and to take off in one-third the distance. It is also interesting to observe that a single-seater version of the Breguet Vultur turboprop-cum-turbojet naval attack aircraft is to be developed for army support. In Korea, the deeds of the piston-engined single-seater Hawker Sea Furies and Chance Vought Corsairs have spoken for themselves.

Load of a Douglas B-26 Invader: twenty-eight 100-lb bombs, four napalm tanks and about 6,000 rounds of ammunition for the 16 guns.

A Lockheed F-80, with six napalm tanks. (Below) F-84F Thunderjet with two auxiliary fuel tanks and eighteen 5in rockets.

A 1,000-lb bomb and two R.P.s attached to the wing of a Supermarine Attacker. Nearby are two other R.P.s and an auxiliary tank.



(Left) Nose of a Gloster Meteor F.R.9 fighter reconnaissance aircraft. (Right) An F-24 camera being removed from a similar aircraft.

RECONNAISSANCE

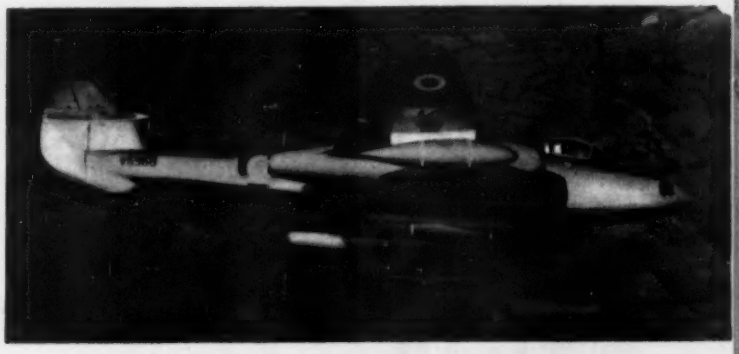
WITH the greatest possible degree of certainty a reconnaissance aircraft, be its application tactical or strategical, must attain its target and return to base, for upon its success may depend air or land operations of the utmost consequence. Thus, it should possess the highest possible speed commensurate with the range, altitude and type of photographic equipment prescribed for its particular mission. Should it be intended for low-level, army co-operation work, manoeuvrability will be another governing factor.

Though specialized aircraft have been tested since the war, none has passed into service, and in general, tactical reconnaissance today falls to the lot of adapted fighters, while strategic missions are generally allocated to specially equipped bombers.

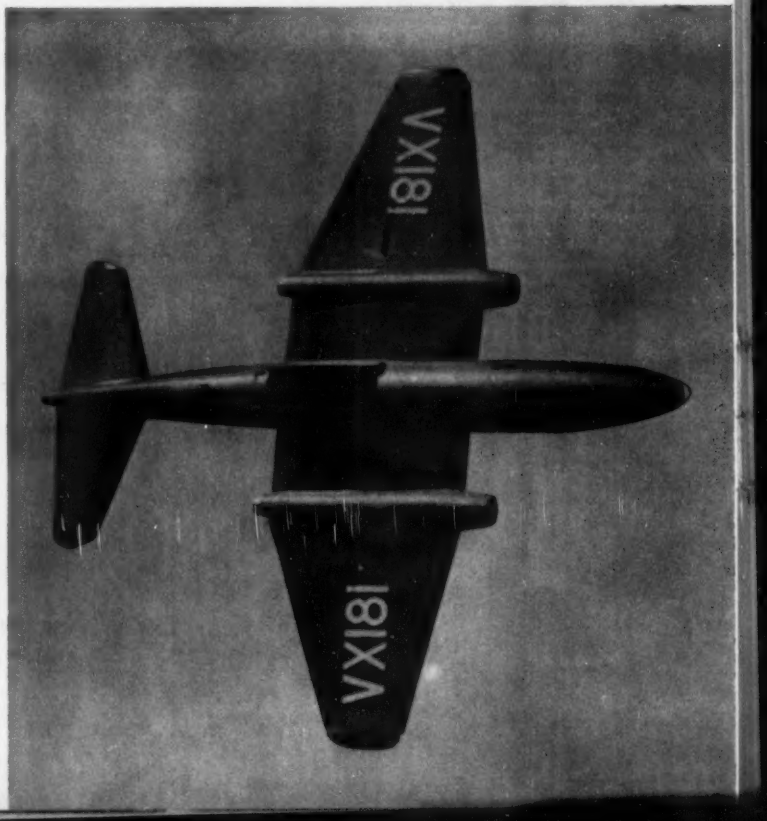
In the R.A.F. two categories are recognized: "fighter reconnaissance," i.e. tactical; and "photographic reconnaissance," by which is implied high-altitude work over relatively long ranges. These class distinctions are somewhat confusing for the F.R. machines are provided with cameras to augment and verify (and, under certain circumstances, to obviate) visual observation by the pilot.

The standard fighter reconnaissance machine of the R.A.F. is the Gloster Meteor F.R.9, a simple adaptation of the fighter Mk 8, wherein the nose section of the fuselage has been modified to house a camera which can be directed to port, starboard or ahead. The mounting is such that the camera may be levelled horizontally or depressed to any angle up to 14 deg, and the normal camera is an F.24 with an 8in or 14in lens, actuated by a switch near the pilot's power lever. The four 20 mm guns are retained and the performance is similar to that of the F.8, the top speed at sea level being 585 m.p.h.

Principal types of R.A.F. long-range, high-altitude (strategic) reconnaissance aircraft are the Gloster Meteor P.R.10 and English Electric Canberra P.R.3, the former being a long-span variant with a "photographic" nose similar to that of the F.R. machine, but having, in addition, provision for a vertical camera further aft in the fuselage. The P.R.10 attains a ceiling of 47,000ft and with a fuel capacity of 795 gal can cover a distance of 1,380 miles and remain airborne for 3¼ hr.



Shown above with ventral and wing tanks is a Meteor P.R.10 high-altitude reconnaissance aircraft. Below is an English Electric Canberra P.R.3, showing camera ports and the bay for flares, etc.



- V.S. 508
- VENOM
- METEOR
- VALIANT
- AVRO 707
- WYVERN
- ATTACKER
- FIAT G.80
- HAWKER 1067
- GLOSTER G.A.5
- ARSENAL V.G.90
- BOULTON PAUL P.111
- MYSTERE M.D. 452
- AVRO C.F. 100
- FAIREY F.D.1.
- FOKKER S.14
- SEA HAWK
- CANBERRA
- OURAGAN
- D.H. 110
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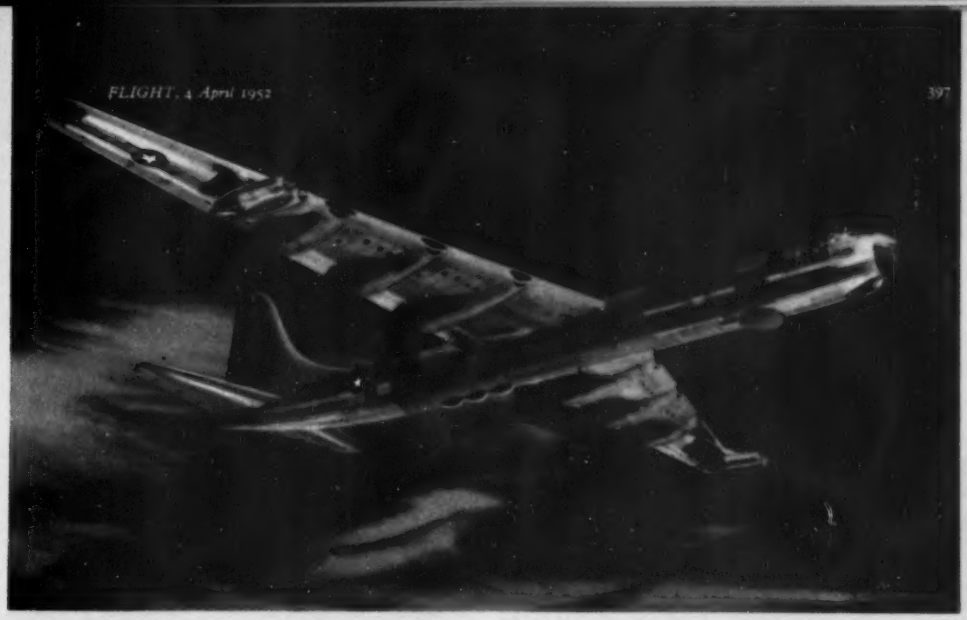


Capable of flying further (and presumably higher) than the adapted Meteor, the Canberra P.R.3 appears, from a cursory examination, to have provision for seven cameras.

Counterpart of the Meteor F.R.9 in the U.S.A.F. is the Lockheed RF-80, the hinged nose section of which can accommodate various combinations of cameras, up to five in number. As a replacement for this type in the Tactical Air Command a development of the "swept Thunderjet," designated RF-84F, has been ordered in quantity; on this machine the air intakes for the Sapphire turbojet have been transferred to the wing-roots.

In the U.S.A.F. long-distance strategic reconnaissance falls to both piston-engined and jet-propeller aircraft, in the former category being the Boeing RB-29 and RB-50 Superfortresses, and Convair RB-36. For the present the sole jet-propelled type is the North American RB-45 Tornado, but, eventually, a variant of the Boeing B-47 Stratojet will be introduced. The RB-50D carries a total of nine cameras in addition to bombs, special radar and flight-refuelling gear, and the RB-36 has provision for fourteen cameras—one of them with a 42in focal length—in the bomb bay. The RB-45C has five camera positions, in the nose and bomb bay.

For naval service a development of the McDonnell Banshee, designated F2H-2P, has been produced to carry six types of camera, interchangeable for various missions. During 1949 an experimental Banshee took a series of widely publicised pictures of Washington from heights between 48,846ft and 51,089ft, using a CA-8 cartographic camera, achieving, on the same flight, a maximum height of 52,000ft. The U.S. Navy also has a photographic reconnaissance version of the Grumman Panther. For longer range a new version of the North American Savage, designated AJ-2P, is being developed, and provision made for eighteen camera installations, not all for simultaneous use.

At the head of the page is a Convair RB-36D, which has provision for fourteen or more cameras.

(Upper right) A McDonnell F2H-2P Banshee, showing the specially developed "photographic" nose.

(Right) A North American RB-45C is refuelled from a Boeing KB-29. The special nose of the RB-45C is visible.

English Electric Canberra B.2 bombers of an R.A.F. squadron—the first to be equipped with this high-flying, extremely manœuvrable machine.

BOMBERS

THE most pressing problems associated with the high-altitude fighter (maintenance of speed, climb, manœuvrability and gun-platform stability at height, and target recognition and tracking) are now fairly widely appreciated; but those besetting the designers of high-altitude, longe-range bombers are of even greater complexity and less firmly grasped. Attainment of the target in itself introduces a multitude of technical considerations affecting range, speed, height, crew-efficiency and defensive capabilities. But the problems of the outward flight are a mere prelude to the real business in hand, for the bomber takes the air with the sole object of placing its bombs on the target; and even if successful in this it must—being a grievously expensive piece of equipment, and having a highly trained crew committed to it—return safely to base. All of which is elementary but not deeply enough comprehended even by some people intimately concerned.

Though the long-range bombing problem is, indeed, a complex one, a few of the major considerations may be outlined. If it be assumed that a jet-propelled bomber has taken off successfully (and this phase in itself may be in the nature of a major operation) it must next ascend to a height which will be dictated by the range required and by the need to complicate the enemy's interception problem. The climb-to-height and outward journey must be conducted according to a meticulously prepared flight plan; but, here again, formidable difficulties and dangers may present themselves, even should the most efficient navigational aids be utilized. Most menacing of these difficulties are the unpredictable wind-speed, wind-direction and temperature changes at height, adjustment for which may be ruled out by inadequate fuel allowances. So the human enemy may often benefit from—though he can certainly not count upon—potent natural allies as a complement to his fighters and anti-aircraft ground defences.

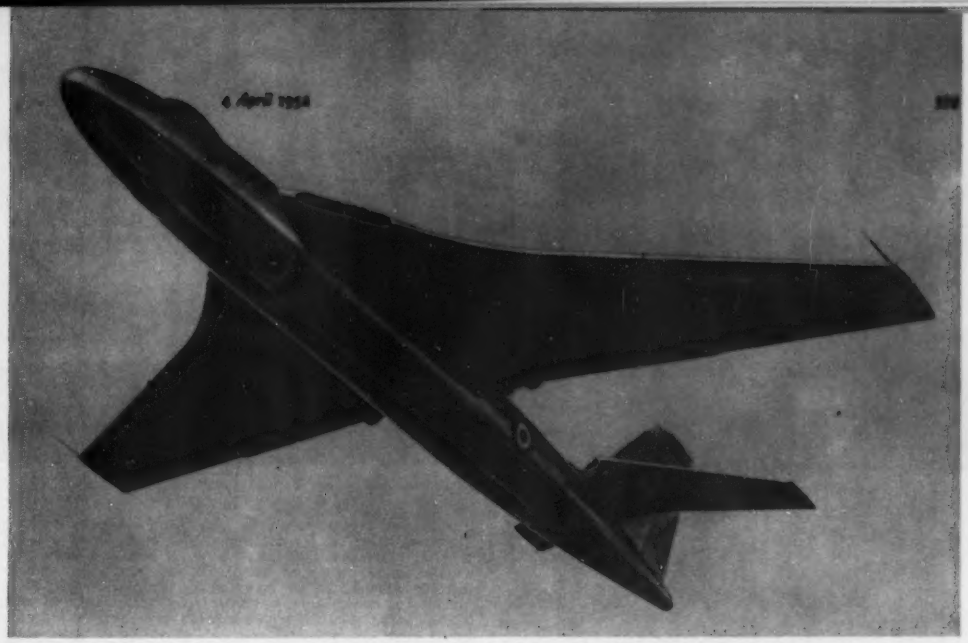
Should intercepting fighters bring the bomber to action, it must either fight as it flies or, if its technical characteristics and other circumstances allow, it may take such evasive action as is possible. As soon as it manœuvres, however, it will decrease its effective range and endurance, and, even if it comes through an engagement with its main structure and power plant unharmed, it may sustain damage to its pressure cabin sufficient to necessitate prompt descent to lower levels, where life may be sustained. But to the jet bomber reduced height can mean drastically reduced range, perhaps necessitating abandonment of a sortie or, in an extreme case, of the aircraft also, in the realization that return to friendly territory is impossible.

Let it be assumed, however, that the outward flight has been successfully accomplished, and the bomber—by virtue of its height, speed or weather cover—is still unmolested by enemy fighters. It now remains first to locate the target and then to deliver the bomb or bombs squarely upon it. From a height of 45,000-50,000ft the target must be spotted from a horizontal distance of 40 miles or more; but even under the most favourable daylight conditions visual identification will be prevented by the haze which, at such altitudes, screens all objects in the region of the horizon, demanding radar for its penetration. Of such equipment little may be said, except that the American K-1 equipment weighs about 2,000 lb and costs 250,000 dollars. Like other radar it is subject to detection and jamming by the enemy.

True, by descending to a lower level the pilot might ease the task of his bomb-aimer; but at the same time he may be exposing his aircraft unduly to ground and air action and, as already intimated, if the machine be jet-propelled, its range must be seriously—perhaps prohibitively—curtailed.

It remains to add that, even when the bombs are finally slipped, their trajectory may be disastrously affected by the aerodynamic forces suddenly acting upon them, and they may strike, after their fall of several miles, well wide of the mark. The dubious accuracy

Boeing B-47 Stratojets of the U.S.A.F. In its present form the B-47 has six General Electric J-47 turbojets. Forward of the insignia are take-off rockets.



Aerodynamic characteristics of the Vickers-Armstrongs Valiant B.1 (four Rolls-Royce Avons) are here revealed to particularly good advantage.

of conventional bombs and sighting methods is spurring development of air-to-ground guided bombs and missiles, such as the rumoured "Rascal," adapted from the supersonic Bell X-1 research aircraft.

In America, Russia and Great Britain the present is a time of the most anxious experimentation with new types of jet-propelled bombing aircraft—anxious because a situation has arisen wherein these machines are already in the hands of the appropriate Services, though many technical and operational questions are as yet unanswered. Meanwhile, the world's long-range bomber forces are still composed mainly of piston-engined machines, and it is these types which will first be reviewed, insofar as appears necessary.

R.A.F. Bomber Command continues to operate two types—the British-built Avro Lincoln and the American Boeing B-29 (Washington). The diehard Lincoln (originally known as Lancaster 5) carries 3,000 lb of bombs for 4,450 miles, 14,000 lb for 2,800 miles, or 22,000 lb for 1,350 miles. It is armed with four 0.5in and two 20 mm guns (the latter in a dorsal turret), but the crew accommodation is unpressurized. Consequently, as the maximum cruising speed of 244 m.p.h. is attained at a height of 25,500ft, crew comfort under operational conditions is not all that might be desired.

The Washington is officially stated to carry 20,000 lb of bombs further than the Lincoln can carry 12,000 lb, and, into the bargain, is pressurized for operation up to 35,000ft or so. It is commonly armed with ten 0.5in guns in remotely controlled turrets. In R.A.F. service a crew of eight (pilot, second pilot, engineer, signaller, navigator, radar operator and two gunners) is normal, though U.S.A.F. crews generally number eleven.

Numerous squadrons of B-29s continue in U.S.A.F. service and the type has been active in Korea, though, due to the depredations of the Migs, it has perforce been relegated to night bombing. Many have already been adapted as flight-refuelling tankers.

With its original Wright R-3350 Cyclone 18 engines the B-29 reached its development limit some years ago, and the decision was taken to redesign for Pratt and Whitney R-4360 Wasp Majors. The outcome was the B-50, wherein 75 per cent of the airframe design is new. For an equal range the B-50 cruises some 27 per cent faster than the B-29, and the maximum speed at altitude is in the region of 400 m.p.h. The normal armament is thirteen 0.5in guns disposed in General Electric remotely trained and electrically operated barbettes above and below the fuselage, and in a tail position. As on the B-29, a central gun-laying system is used whereby any one gunner (except the one in the tail) can assume control of more than one of the five gun installations at one time. The fire-control system embodies a computor which automatically adjusts for lead angle, air density, windage, range, speed and gravity.

The B-50D attains an absolute ceiling of about 40,000ft and cruises at 30,000-35,000ft. At 25,000ft the cabin altitude is 5,500ft. Internal stowage is provided for 20,000 lb of bombs, but with external carriers (alternative to auxiliary tanks) a load of 28,000 lb is possible. The auxiliary tanks extend the range beyond the 6,000 miles possible with a five-ton bomb load and with internal

The study of the twin-Avon English Electric Canberra is illustrative of its climbing powers. On the right is the first prototype Short S.A.4 (four Avons).

A Consolidated Vultee B-36D, with six Pratt and Whitney Wasp Major piston engines and four General Electric J-47 turbojets.

fuel alone, and many B-50s are equipped for flight refuelling. It was with this aid that the B-50 *Lucky Lady II* made its historic non-stop round-the-world flight of 23,452 miles in 94 hr 1 min during 1949, with four in-the-air replenishments.

The third—and by far the largest—type of piston-engined bomber in U.S.A.F. service is the jet-assisted Convair B-36, around the vast and astronomically expensive bulk of which controversy still buzzes. There is increasing evidence, however, that this "heavy" bomber (it is the only machine so designated in the U.S.A.F.) possesses in high degree certain qualities denied to smaller, more lissom, machines capable of more spectacular performance at lower levels. As Mr. Curtis Fuller has so nicely expressed himself in our contemporary *Flying*: "At one time the Air Force was about ready to write off the B-36 as a useless cow that might possibly serve as a tanker but never as a combat bomber operating without fighter escort. But then the Air Force found that the old cow had unexpected performance at high altitude and after jet engines were added to it the planners suddenly awoke to the astounding fact that they had no fighters which could shoot it down with any consistency." And, as will later be seen, the "useless cow" seems amenable to further far-reaching developments

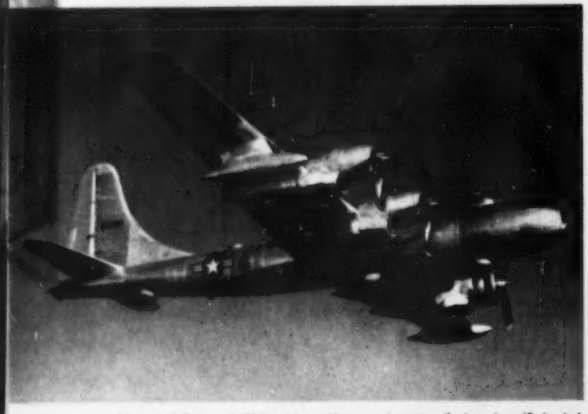
The standard B-36 sub-type is the "D," powered with six Pratt and Whitney R-4360-41 Wasp Majors delivering a total of 21,000 h.p. to Curtiss Electric pusher propellers. Additionally there are four General Electric J-47 turbojets (aggregate thrust 20,000 lb—equivalent to about 19,000 h.p.) mounted in underslung nacelles far outboard, so that power plants are strung out over the greater part of the 230ft, slightly swept, wing. The last of 100 B-36As and B₁s, with piston engines only, have lately been modified to "D" standard and other brand-new "Ds" are coming off the production line.

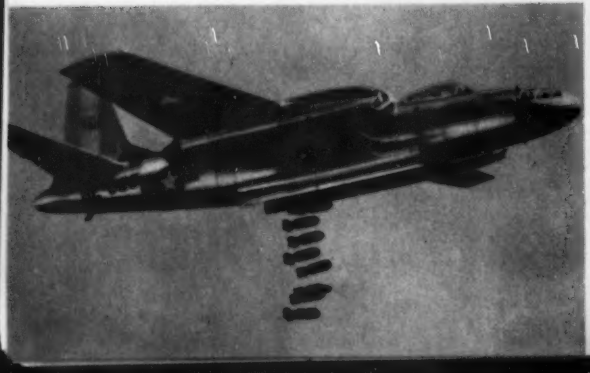
The crew of fifteen or more are housed in two pressurized sections of the fuselage, fore and aft of the bomb bay, physical intercommunication being (literally) by way of a tube railway, some 85ft long. The armament of sixteen 20 mm guns is disposed in six retractable, remotely trained, barbettes, and in nose and tail positions; thus, in cruising flight the only drag attributable to this formidable armament is that of the small sighting domes. These, in any case, serve as scanning points for crew members detailed to watch continuously for oil and petrol leaks, loose cowlings, icing, etc.

When the first B-36s arrived in this country last year on a training flight it was learned that the anti-icing and de-frosting system uses engine air passed through exhaust-gas heat exchangers, and then ducted between the double skin of the wing and tail surface leading edges, between the double glass of the bomb-aimer's and pilot's enclosures, and to the gun-sighting domes.

At take-off all ten power plants are generally in action, though from a 10,000ft runway the jets are not indispensable, even at the maximum flying weight of 358,000 lb. It is usual to continue the jet-assisted climb to about 10,000ft before shutting down the four jets and continuing on piston engines alone. To attain bombing height the jets are brought in again and remain operative as the target area is approached. Thus, if a B-36 were raiding London, the jets might be started over Prestwick. Over-target speed is claimed to be in excess of 435 m.p.h. and the service ceiling over 45,000ft. The jets remain in operation until the machine is clear of the target area. The maximum bomb load of the B-36D was originally quoted as 84,000 lb, but a later, unofficial figure of 75,000 lb may be more realistic. Combat radius with reduced bomb load is generally accepted as being over 4,000 statute miles.

As is now well known, the standard, long-range piston-engined bomber of the Russian Air Force (supposedly designated Tu-4) is a copy of the B-29, but concerning the armament, equipment and other characteristics of this machine we lay no claim to any positive knowledge. It can, however, be said with confidence that some hundreds of these bombers are in service and that Russia is developing a newer, larger and faster type. Of this, General Vandenberg has said that, though smaller than the B-36, it could have a radius of action extending from Soviet bases deep into the United States. It is widely believed that airframe design follows the pattern of the jet-propelled Boeing B-47 but that, instead of turbojets, there are six turboprops, driving tractor airscrews. Should this prove true, the Soviet machine would be the only





(Above) A Boeing B-50D with auxiliary under-wing fuel tanks. (Below) A North American B-45 Tornado releases a salvo of bombs.

long-distance bomber in the world having turboprop power (other than the experimental carrier-borne North American Savage development referred to under the heading "Carrier-borne Strike Aircraft").

There is still a distinct possibility that a number of forthcoming long-range bombers will be driven by turboprops, using very advanced types of airscrew; in fact, Convair are said to be working on a new "intercontinental" bomber (additional to the pure-jet YB-60, later mentioned) powered either by a turboprop version of the Curtiss-Wright J-65 (Armstrong Siddeley Sapphire) or by a similar development of the Pratt and Whitney J-57. Boeing, moreover, are considering a turboprop development of their B-47, likewise with Curtiss-Wright Sapphire-type turboprops, and for this development a range nearly twice that of the jet-propelled B-47B has been suggested. Meantime, however, interest is concentrated on pure-jet machines typified by the American Boeing B-47 and B-52, and North American B-45, Britain's Vickers-Armstrongs Valiant and English Electric Canberra, and certain Russian designs.

For convenience these jet bombers will be considered according to whether they have four or more jets or only two—an arbitrary segregation, but one which approximates to the accepted "strategic"/"tactical" subdivision and which has the additional merit of honesty, for there is no doubt that the so-called "tactical" Canberras would function in a strategic rôle should circumstances allow.

The only British four-jet bombers which may be named, and briefly described, are the Vickers-Armstrongs Valiant B.1 and the Short S.A./4 prototypes, both with Rolls-Royce Avon turbojets. Perhaps the cleanest multi-engined aircraft yet built, the Valiant, displays, when compared with its nearest American counterpart the Boeing B-47 Stratojet, a large wing area, and the wing roots are of sufficient chord and depth (thanks to a sharp sweeping forward of the leading edges) to accommodate the bulk of the Avons. The double-slotted flaps are in three sections and of very large

Uppermost is a B-47 Stratojet, escorted by an F-86. Immediately above is a Martin XB-51 and, below, the first of the vast Boeing XB-52s.

area, and the landing speed appeared at Farnborough last year to be, at most, moderate. The fuselage lines are broken only by the heavily reinforced cockpit enclosure (bespeaking heavy pressurization) and a "blister" fairing under the nose section. Though commonly assumed at Farnborough to contain radar equipment, this fairing is more likely to prove to be the bomb-aimer's position for visual sighting. There is no evidence of defensive armament and the Valiant would rely for protection on its extremely high cruising altitude and speed of over 500 m.p.h. The bomb bay extends from a point in way of the wing leading edge to a station aft of the trailing edge, the rearmost bomb doors tapering in plan towards the tail.

All in all, the Valiant appears to represent a notable technical advance on all previous bombers, and it is a design, moreover, which, by virtue of its relatively low wing loading and engine space, should prove capable of lengthy development. Should it possess one defensive asset more than another, this is likely to be its high operational ceiling, even on the outward flight, before the bulk of its fuel is consumed.

The only official intimation of performance is that the Valiant is superior to the English Electric Canberra in range, capacity, speed and altitude, and here it may be remarked that a Canberra is believed to have attained a height of 48,000ft on a transatlantic crossing, and that another has flown from London to Castel Benito at an average speed of 538 m.p.h. The American press has mentioned operating altitudes of 50,000-55,000ft in connection with the Valiant.

The Short S.A./4 is of more conventional, straight-wing layout than the Valiant, but unusual in that pairs of Avons are disposed well outboard, one unit of each pair being superimposed above the other. Of exceptional capacity, the fuselage is clean-lined, though less shapely than that of the Valiant and B-47. As there has been much ill-informed conjecture concerning this apparently "old-fashioned" jet bomber, it is only just that some explanation should be given.

As part of the Air Ministry bomber policy during the past few years, Short Bros. were asked to build an aircraft which, while possessing relatively high performance characteristics, would not be unduly unorthodox in general layout. In the event the more boldly designed Valiant proved successful and this, though highly satisfactory from the national standpoint, reacted a little unfavourably on the Short company, whose task had been to build the more conventional design.

Despite the fact that the Avons turned out heavier than was estimated in the project stage, the weight increase had, due to the particular design of the aircraft, far less effect on performance than would normally have been expected. Moreover, the manner of mounting them, in addition to facilitating maintenance, resulted in an aircraft that was eminently suitable for the speedy installation of later turbojets and one in which, by reason of the unobstructed air intakes and short tail-pipes, high engine efficiency was secured.

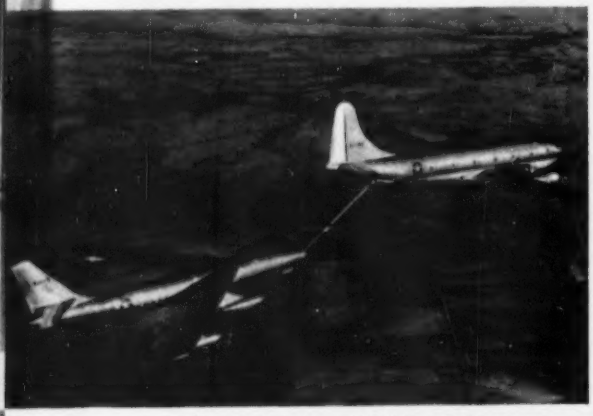
The S.A./4 was designed to accommodate the Air Staff bomber requirements in the matter of radar, radio and similar installations and embodies very advanced ideas in anti-icing, claimed by Short Bros. to be present in very few aircraft today. Thus, the Ministry of Supply now have at their disposal a modern type of jet bomber on which to experiment with new weapons and equipment.

The U.S.A.F. has in service the North American B-45 Tornado, with four General Electric J-47 turbojets, and is in process of receiving B-47s, with six units of the same basic type. The Tornado, to the reconnaissance version of which reference has already been made, dates from 1945-46 (the first prototype flew in March, 1947) and, although a useful type, is far less modern in concept than the larger, faster B-47. Initially it was considered a "tactical" bomber, but is evidently too large for low-level attacks in support of ground forces. It is a four-seater capable of carrying up to 20,000 lb of bombs (as large a load as the four-engined Lincoln, be it noted); it weighs about the same as the Lincoln (82,000 lb) but is nearly twice as fast; the top speed is in the order of 550 m.p.h.; and armament is two 0.5in remotely controlled tail guns. A tactical radius of more than 800 miles is usually quoted. The B-45 is said to be a good bombing platform and during tests in California released bombs ranging from 500 to 4,000 lb in weight with a high standard of accuracy from heights up to 20,000ft and at speeds over 500 m.p.h. Turbulence round bomb bay was eliminated by using retractable doors which permitted the bombs a clean drop into the airstream.

The B-47 is a vastly different aircraft, very bold in concept, particularly as regards wing design, fast, but of dubious performance at very high altitudes. Design work was put in hand during September, 1945, and the first prototype emerged almost exactly two years later. The maiden flight was on December 17th, 1947, and today a number of B-47s are already in the hands of the U.S.A.F. for familiarization. It is now about six months since the first few of these were delivered to the MacDill Air Force Base, near Tampa, Florida, where they are understood to have been taken over by the 306th Bombardment Group, training element of the 6th Air Division. As was to be expected, a host of "snags" materialized, a number of which concerned the electronic equipment for the twin, remotely controlled tail guns—the sole defensive armament. Other difficulties were experienced in opening and closing the bomb doors at speeds above 550 m.p.h.—and once these were mastered the question arose how to keep the internal "plumbing" from being torn out. At the time of writing no squadron has been declared operational.

On February 8th, 1949, a B-47 prototype covered the 2,289 miles between Moses Lake, Washington, and Andrews Air Force Base, Maryland, at an average speed of 607.8 m.p.h., and from this performance and other evidence it would appear that the machine is appreciably faster than the Canberra—at medium heights, at least. It has been suggested, moreover, that a standard B-47 is capable of outstripping the Valiant prototype, though, even if

A Boeing B-47 makes a spectacular assisted take-off.



A B-47 flight refuels from a KC-97A Stratofreighter tanker. (Below) A parachute-arrested landing by a B-47.

proved true, this would not be of great significance, for the Valiant will obviously be developed with turbojets of far greater thrust than those initially installed. With an unspecified bomb load the range of the B-47 has been quoted as 3,000 miles, giving a tactical radius of about 1,200 miles, but these figures can be improved by the addition of under-wing tanks, for which provision is made in the B-47B, or by flight-refuelling equipment, which is installed in a number of B-47s.

Aerodynamically the B-47 is of exceptional interest, as can be believed when it is realized that the design called for something like 5,000 hr wind-tunnelling against 250 hr for the pre-war B-17 Fortress. A report of supersonic speed in a shallow dive, however, remains unconfirmed.

The "podded" arrangement of the six turbojets (the experimental B-47C will have only four units, of higher power) was decided primarily by the thinness of the wing and the desirability of interfering as little as possible with the wing flow. So pliant is the wing, incidentally, that in level flight it has flexed 42in or so from dihedral to cahedral. Other design considerations were the reduced fire danger, ease of access and, it is said, favourable effects on stalling characteristics, flutter speeds and longitudinal stability. Due to unknown variables affecting control surface hinge moments at high Mach numbers, all flying controls are operated by irreversible hydraulic servos, with artificial pilot "feel" and centring.

As neither the wing nor any of the jet nacelles offered stowage for the undercarriage, it was decided to accommodate this in the fuselage, the main assemblies being arranged in tandem fore and aft of the bomb bay. Retractable outrigger wheels provide lateral stability. Take-offs are made with full flap and at the unstick point the B-47 flies off the ground with the elevator near neutral. The ground run is long under all conditions, but is much improved by the auxiliary rocket installation. At present there are two groups of nine solid-fuel rockets, providing a total emergency thrust of 18,000 lb.

Rapid descents from high altitude are made with the undercarriage lowered. The touch-down speed is high, and it is admitted that a disadvantage of the tandem undercarriage is that the range of speeds and attitudes through which smooth landings can be made is more limited than with other designs. Highly effective braking is provided by a tail parachute, in addition to which the wheels have anti-skid devices.

Far larger and heavier than the B-47 are two new U.S.A.F. bombers, foreseen as replacements for the composite-powered Convair B-36 already discussed. One of these, the Boeing XB-52, is a wholly new design (though closely resembling the B-47), whereas the second, the Convair YB-60, is a swept-wing adaptation of the B-36 itself. Thus, a pronouncement by an American colleague that the Boeing should be the better and the Convair the cheaper may well be credited—the cost of the first XB-52 is said to work out at about 250 dollars a pound. Of two XB-52 prototypes, one is complete (the only photograph released is reproduced herewith) and a second is well advanced. Production has been ordered, though the extent of this will depend on the result of comparative trials against the YB-60. The power plant is eight Pratt and Whitney J-57 turbojets, which, according to American reports, deliver about 8,000 lb thrust each and, being of dual-compressor type, give reduced fuel consumption for somewhat increased weight.

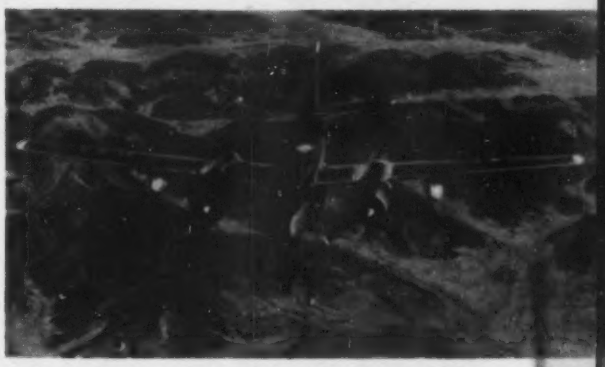
Though somewhat smaller and lighter than the B-36 (the gross weight is probably about 350,000 lb), the B-52 is said to have been designed to meet similar requirements: namely, that it should carry a 10,000 lb bomb load for 10,000 miles. The wings and tailplane have a 35-deg sweepback and a complement of nine, including a relief crew, is reported. As in late-model B-47s, they will be ejected downwards for escape, in special Stanley seats.

The Convair YB-60, two prototypes of which are on order (the first was nearly complete, except for power plant, last October, and the second is well advanced) is a pure-jet swept development of the B-36 with eight Pratt and Whitney J-57s. As on the B-36, some 9,000 lb of magnesium is used in the structure. The inner wings are believed to be similar to those of the standard B-36, but the outer panels have a 35-deg sweep. Roughly 72 per cent of the structure is identical with that of the B-36; in particular the whole fuselage between the cockpit and a point near the tail remains unchanged. The nose, however, has been modified and a tail parachute installed. A crew of eleven is intended, including a relief crew of four.

Of these vast new American machines little more can be said, and of new British projects nothing whatsoever has been divulged—even in the House of Commons! An American contemporary, however, maintains that it is an open secret that the Avro 707A and 707B delta-wing research aircraft are the heralds of an ultra-high-altitude sonic jet bomber being built by A. V. Roe at Manchester, and that the crescent-wing H.P.88, which was destroyed in an accident last summer, was a test-bed for a Handley Page high-altitude bomber with "compound leading-edge-taper wing."

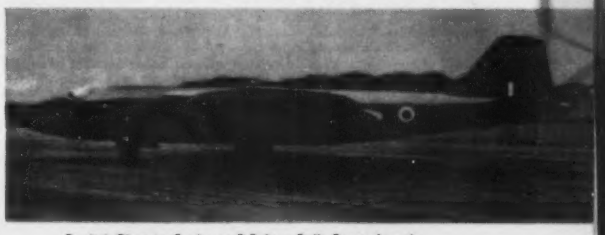
With such new shapes new power plants might harmonize—

Bristol Brigand B.1 (two Bristol Centaurus piston engines).



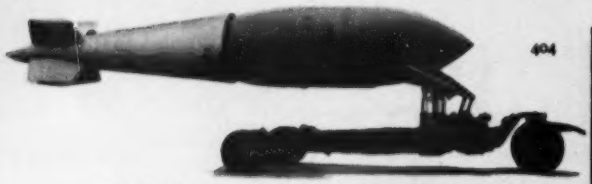
Douglas B-26 Invader (two Pratt P. and W. Double Wasp piston engines).

Russian "Type 27" bomber (two Nene-type turbojets).



English Electric Canberra B.5 (two Rolls-Royce Avons).

French S.O. 4000 prototype light bomber (two Hispano Nenes).



A 22,000 lb bomb on a Boeing loading cradle, operated by a petrol engine.

dual-compressor, by-pass, or ducted-fan jet units or highly developed turboprops. Further ahead still even stranger shapes—determined by the necessity for protecting their crews against the radiation of their atomic power plants—may be visualized. But atomic power, with its promise of ultra-long ranges, is still a dream and concerning it little of a factual nature can be said at present, except to record that late last year the Atomic Energy Commission and the U.S.A.F. jointly stated that "complex problems remained to be solved before such a power plant could be made, installed and flown," adding that a contract had been awarded to General Electric for the ultimate manufacture of a nuclear reactor engine. Subsequently it was announced that a second contract had been put out—to the Pratt and Whitney Division of the United Aircraft Corporation—and it was further divulged that this particular unit differed from that on which General Electric were working. Later still it was learned that Convair had been awarded a contract to build an atomic-powered bomber.

It now remains to consider the twin-jet machines, generally classed as "tactical" bombers and intended to take over from such ageing piston-engined types as the de Havilland Mosquito and Bristol Brigand (Great Britain), North American B-25 Mitchell and Douglas B-26 Invader (U.S.A.), and Pe-2 and Tu-2 (Russia).

The sole British example is the English Electric Canberra, with Rolls-Royce Avons as the standard power plant for R.A.F. service, though alternatively fitted with Armstrong Siddeley Sapphires. An American contemporary has quoted the weight of the Canberra as 46,000 lb and the speed as 550 m.p.h. but, apart from the demonstrated performances mentioned earlier, no official evidence has been forthcoming. Two bomber marks, the B.2 and B.5, are in R.A.F. service, and both have nose panels for visual aiming, that of the B.5 (believed to be a target-indicating variant) being the larger in area. The Canberra can, however, bomb through cloud by means of radar aids. A crew of three—pilot, navigator-plotter, and observer—mans the B.2. To a large extent the two last-named men are interchangeable, though it is usually the navigator-plotter who navigates the machine to the target with radar aids, and the observer who, before the run-in, takes up his position to aim the bombs. There is no signaller and no W/T, the only radio being the pilot's V.H.F./R.T.

The Martin-built U.S.A.F. version of the Canberra, designated B-57A, will be powered with Curtiss-Wright J-65-W-1 turbojets (Armstrong Siddeley Sapphire) and, as already intimated under the heading "Ground Attack," will have a heavy fixed-gun armament in addition to its bomb load. It is known that the bomb bay has been redesigned to accommodate a larger number of small bombs and that special electronic equipment will be installed.

Testing one of the twin 20-mm gun installations of a Convair B-36 bomber. The guns are aimed from sighting blisters some distance away.

The crew will consist of pilot and navigator/bomb-aimer, and a tail parachute will be embodied for use on small and slippery runways. It has been estimated that structural changes and increased tankage will increase the weight by about 15 per cent, but that performance will not be prejudiced because of the higher thrust of the Sapphires compared with that of the original Avons. It is likely that the B-57A will be supplemented by Douglas B-66s, developed from the U.S. Navy's A3D, which is later described.

Fastest of the American bombers is the Martin XB-51, with three General Electric J-47 turbojets. Intended primarily for army-support work, and having fixed-gun armament, the first XB-51 made its maiden flight in October, 1949, and a second has since been completed. Tests are still under way but at the time of going to press there is no intimation of a production order.

The Russian Air Force has for many months been operating squadrons of a new type of twin-jet bomber comparable with the Canberra and known provisionally as the "Type 27." Of Ilyushin design, this machine is powered by two Rolls-Royce Nene-type turbojets underslung from the high-aspect-ratio wing. As on the B-47, tail guns are installed and there are reports of fixed, forward-firing guns in addition to bombs and/or rocket projectiles. A second bomber of similar class is identified as Type 35, but of this machine little is positively known.

Finally, in deference to the U.S.A.F.'s wish that it should be considered a pilotless bomber rather than a guided missile (hence its official designation B-61), we must mention the Martin Matador which, in the view of *Aviation Week*, could be an operational missile in a brief period of time, following "shake-down" tests now under way. A British development along similar lines is mentioned by our contemporary.

A turbojet-powered Martin B-61 Matador pilotless bomber of the U.S.A.F. leaves its launching ramp with the assistance of auxiliary rockets.

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Auster Model "S" (Cirrus Bombardier).

Cessna L-19A (Continental O-470).

SPOTTING AND LIAISON

THE principal aircraft to be considered under this head are the small fixed-wing "A.O.P." (air observation post) machines, typified by various British Austers; the Convair L-5 and L-13, Boeing L-15 and Cessna L-19 of the U.S.A.F.; France's Max Holste 152 and the Danish K.Z.X. These tractable, versatile little high-wing monoplanes afford a wide field of view and are noted for their ability to fly under full control at low speeds and to operate from confined, unprepared spaces. They are frequently adaptable for floats or skis and are suitable for artillery observation, communications (liaison), light transport, cable-laying and similar duties. From amongst them the Auster Model "S" may be selected as being the most recent in design.

In the Model "S" the observer's seat can face sideways or rearwards, and alongside the pilot is provision for radio which, with its mounting, can be removed within a few seconds. The all-up weight is 2,025 lb; take-off run (still air), 115 yd; take-off distance to 50ft, 240 yd; landing run from 50ft, 250 yd: max. rate of climb, 1,200ft/min; and still-air range, 230 miles. A two/three-seat production variant now under development to meet an official requirement will have a considerably improved performance and weight-carrying capacity.

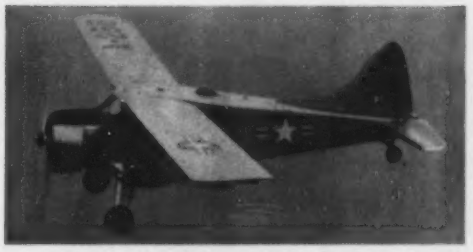
It is machines such as these which can benefit more than most from efficient high-lift devices and, ultimately perhaps, from boundary-layer control; estimates show, in fact, that this latter system might reduce landing distances by 25-40 per cent.

A machine of somewhat different character, and one which might well be included under the heading "Transports," is the new Auster Ambulance/Freighter, first tested in the field during British manœuvres last year. This will operate from the same forward areas as the observation machines but, with its remarkably roomy fuselage and rear-loading doors, can be used as an ambulance, light freighter or supply-dropper.

Again diverging sharply in design from the usual run of A.O.P.s is the Ryan L-17, military version of the private-owner Navion. This is a comparatively fast (155 m.p.h. cruising) low-wing machine which, in addition to its liaison and spotting duties, has proved its worth in Korea in locating tactical targets, on to which it has sometimes led the fighter/bombers brought up as the result of its observations.

Deliveries are now being made to the U.S.A.F. and U.S. Army of L-20s, military versions of the high-wing de Havilland Canada Beaver, carrying a payload of nearly 1,000 lb and capable of taking off in no wind in about 270 yd.

Though it is evident that small (1/3-seater) helicopters have much to commend them for liaison, spotting and casualty work, relatively few are at present so employed. Types which come to mind as being particularly suitable are the Saunders-Roe Skeeter, Hiller Hornet, and the American Helicopter Company's XH-26, a tiny ramjet machine which can be dropped in a container from a transport aircraft, unpacked by two men, and put into the air in 20 minutes. Additional to the pilot, it will lift two men, in external litters, and will cruise at 80 m.p.h.



de Havilland Canada Beaver (P. and W. Wasp Junior).

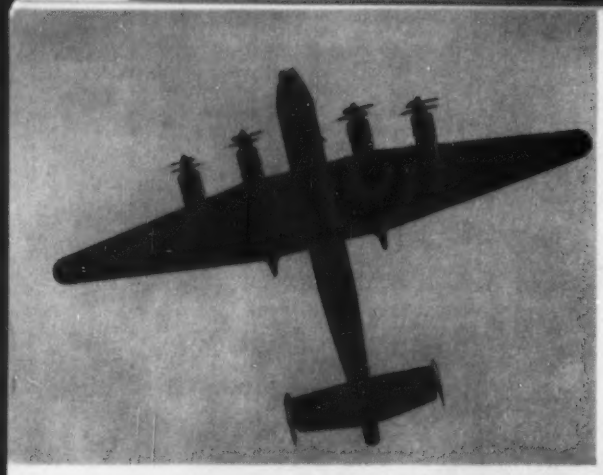
Ryan L-17B (Lycoming GO-435).

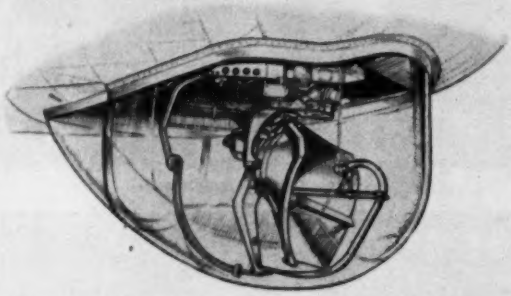
Skandinavisk Aero Industri K.Z.10 (Continental C145).

Max Holste 152 (Salmson-Argus).

Saunders-Roe Skeeter 3 (Cirrus Bombardier).

Auster Ambulance/Freighter (Cirrus Bombardier).





The radar installation of the Avro Shackleton M.R.1, seen in this "Flight" sketch, is located under the nose, as shown in the photograph, left.

MARITIME RECONNAISSANCE

ANSWERING to this description are large- and medium-sized landplanes and flying-boats with two or four engines and primarily intended for over-water patrol, shadowing and anti-submarine action. While landplanes predominate, it is nevertheless recognized that a global conflict would afford abundant opportunities for—indeed, demand—long-range flying-boats capable of operating at high intensity with the minimum of shore facilities.

In succession to adapted Avro Lancaster bombers, R.A.F. Coastal Command is re-equipping with Avro Shackleton M.R.1s, for which four Rolls-Royce Griffon piston engines, developed specifically for cruising economy at medium and low altitudes, provide power. Optional nose armament is two 20-mm guns, in remotely trained barbettes, and a similar armament is installed in the dorsal turret. The weapon bay is of exceptional capacity and, though specific figures are withheld, it is claimed that a high rate of climb is attainable to ensure a quick getaway after a surface attack. This climb might be assisted with water/methanol injection, which would, in any case, assist take-off under tropical conditions. It is claimed for the Shackleton that it could return to base with two engines out of action.

The smaller twin-engined Lockheed Neptune, supplied not only to the U.S. Navy but to Britain, Australia and South Africa may be described in rather greater detail. Later Neptune variants are among the first aircraft to have Wright Turbo-Cyclone 18 engines, and it has been estimated that, had the early Neptune *Truculent Turtle*, which established the world's long-distance record of 11,236 miles in 1946, been so powered, the distance might have been increased by as much as 2,200 miles. Gun and projectile armament of the Neptune has varied considerably through the range of sub-types, the P2V-5 having twin, turreted 20-mm guns in place of the fixed armament of some earlier marks. Specific internal loads for the P2V-5 may not be listed, but it is believed that the following are typical: 12 × 325-lb depth charges, 16 × 500-lb bombs, a quantity of sea mines or two torpedoes. Rocket projectiles, including Tiny Tims, can be disposed under the wings. Submarine-hunting gear may include a large external radome or magnetic detection equipment (at the expense of part of the war load), and a quantity of sonobuoys. Wing-tip tanks contain extra fuel and a searchlight.

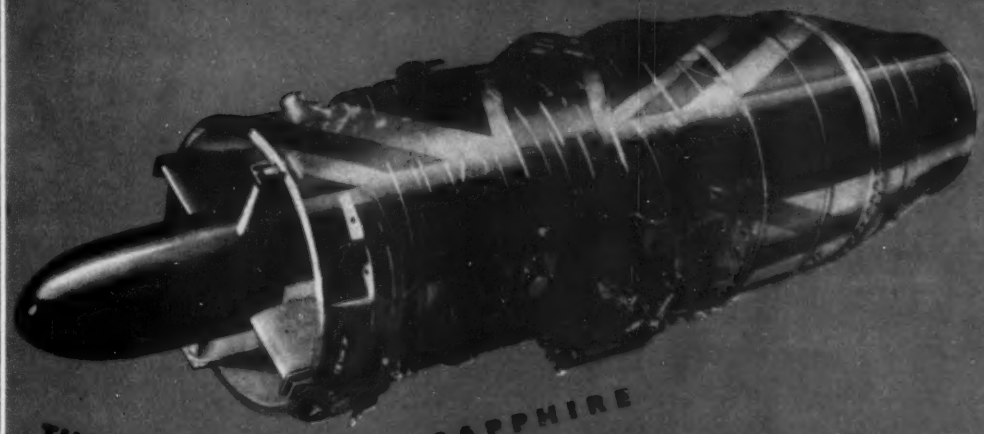
The sonobuoys are carried internally and are dropped in an area where a submarine has been located. They float on the surface and each contains a microphone, which is lowered to a prescribed depth, where it picks up the noise of the submarine's propellers. This it relays by a small radio set to the aircraft itself, wherein special equipment determines the position of the submarine.

Also in U.S. naval service are a small number of Martin Mercators, larger and—having two turbojets in addition to their piston engines—faster than the Neptune. France has taken over a quantity of reconditioned Lancasters for maritime reconnaissance work and is experimenting with a development of the Bréguet Deux Ponts freighter, designated Type 764, equipped for anti-submarine operation and having an endurance of 24 hours with a war load of about 10,000 lb.

While the principal weapons of the aircraft named are bombs, depth charges, torpedoes, mines and rockets, there appears to be no doubt that in due time air-to-sub-surface guided missiles will be taken into service.

Engines of the Lockheed Neptune are Wright Turbo-Cyclones; the Martin Mercator below it has two Wasp Majors and two J-33 turbojets.

A Goodyear "blimp" of the U.S. Navy, equipped with magnetic submarine-detection gear—particularly effective on this class of aircraft.

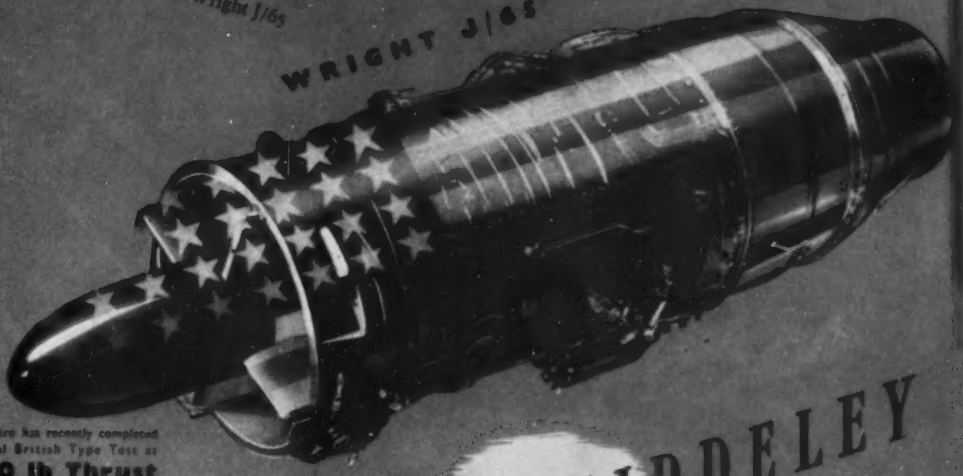


SAPPHIRE

THE ENGINE OF THE NORTH ATLANTIC TREATY ORGANISATION

The Armstrong Siddeley Sapphire high-thrust* turbojet is now being manufactured under licence by the Wright Aeronautical Corporation in the United States of America, where it is known as the Wright J/65

WRIGHT J/65



* The Sapphire has recently completed an official British Type Test at **7,500 lb Thrust** (subject to confirmation)

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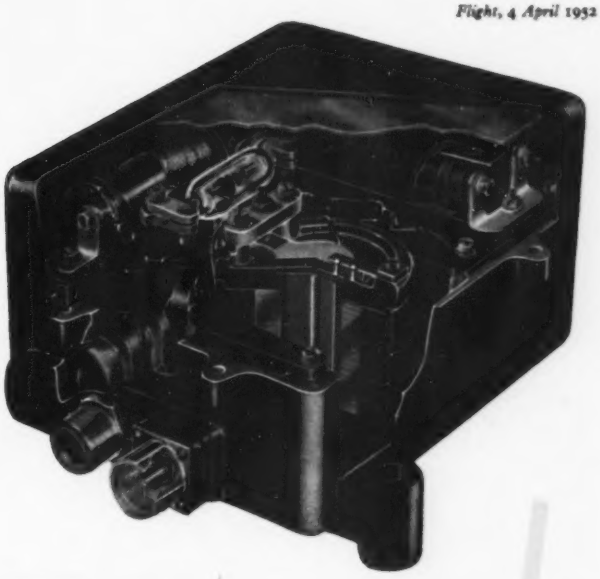
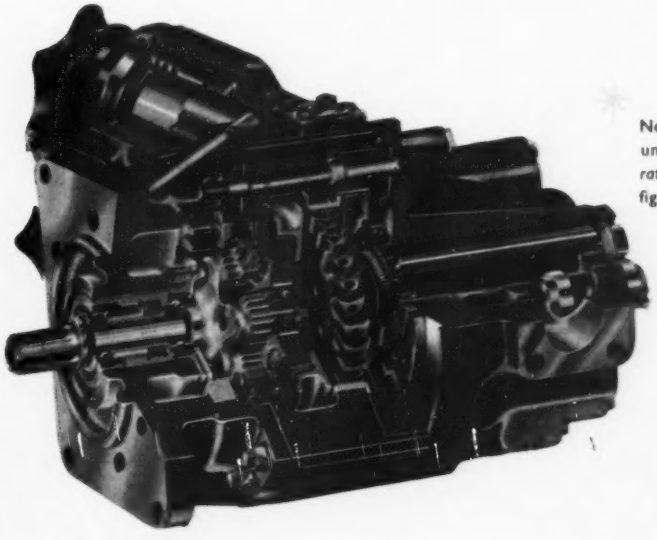


This high energy ignition unit, now in production, is designed for lighting gas turbine engines during rapid acceleration starting, and for relighting at high altitudes.

Rapid starting equipment for gas turbines



Now in production, this Rotax unit provides the *rapid acceleration starting* needed on jet fighter aircraft.

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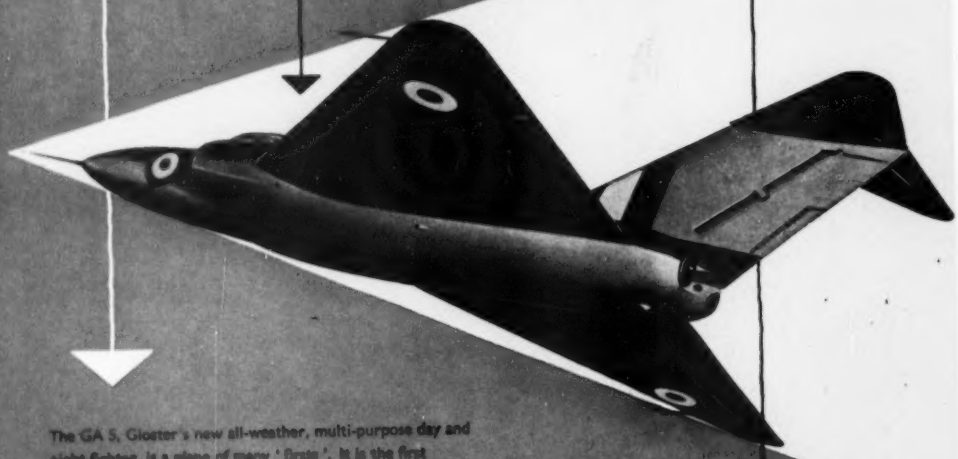
First Twin Delta Fighter



The GA 5, Gloster's new all-weather, multi-purpose day and night fighter, is a plane of many 'firsts'. It is the first operational Delta fighter produced in Britain. The first twin-engined Delta fighter to fly anywhere in the world. The first fighter after the Sapphire Meteor to carry a power plant exceeding 14,000 lbs. of static thrust, delivered by two mighty Armstrong Siddeley Sapphires. It is the first operational aircraft to spring from the brilliant research pioneering on the Delta plan-form undertaken by the Hawker Siddeley Group. Such leadership is not surprising, however, when you remember that Gloster also gave the world its first successful turbo-jet aircraft, the historic Whittle E.28/39 and the first jet plane to go into squadron service, the Meteor Mark I in 1944. Being 'first' is a Gloster tradition.

GA/5

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Turboprop-powered Convair XP5Y-1. Note lateral gun barbettes.

Martin Marlin (Wright Turbo-Cyclone engines), showing bow radar.

MARITIME RECONNAISSANCE

A more highly specialized class of aircraft which it is appropriate to mention under the present head is the large "early-warning" or "picket" machine, typified by the Lockheed PO1-W and PO2-W (now redesignated WV-1 and WV-2 respectively). These are Constellation developments and carry what is said to be the most advanced and highly sensitive airborne radar in existence.

Alone, it seems, among the nations of the world America continues to develop and exploit the "blimp" airship for submarine detection and coastal patrol. These ships are of Goodyear design and construction and have rendered yeoman service in the past as convoy escorts. They are particularly suitable for the operation of magnetic detection gear but are less useful in administering the *coup de grâce*.

For the following notes on the latest ZPN (*Nan*) of the U.S. Navy we are indebted to James H. Winchester, writing in our American contemporary *Flying*. *Nan* was designed specifically for long-range anti-submarine patrol and detection, and cost about five million dollars. She is a prototype for four others now under construction and more are likely to be ordered. Measuring 324ft in length, the ship has a capacity of 925,000 cu ft and is powered with two 1,300-h.p. engines mounted inside the streamlined gondola. The crew numbers 14, and they are quartered on the upper deck. Beneath the gondola is a vast radome and on the port side a large million-candle-power searchlight. "Lighter-than-air students," writes Mr. Winchester, "are not surprised that their big-bellied pets are once again in the spotlight. When anyone acts as though the present rôle of the blimps is anything new or different they point proudly to World War II record books." (It is still not generally known that during the war American non-rigids escorted 89,000 ships in 55,900 operational flights, during which no vessel was lost in any convoy attended by them. Only one airship was lost to enemy action.)

Just as blimps appear to be coming back into their own, so are flying-boats once more in the ascendant—in America at least where, immediately after the war, it appeared that they were lapsing in favour in face of very efficient landplanes. The Martin Marlin, now in production for the U.S. Navy, is a radical development of the last-war Mariner and is primarily for anti-submarine service, though it can be used alternatively as a freighter or general utility machine. Armament is said to include both internal and external stores, and it is known that bombs are carried in the engine nacelles. These boats are very advanced in hydrodynamic design and have the long afterbody which is the modern fashion. To improve handling qualities on the water there are hydro-flaps, or rudders, near the stern, which can be operated independently or together and greatly reduce the turning radius.

The Convair XP5Y-1 is being developed for anti-submarine and transport operations, and is powered with four Allison T-40 turboprops, each consisting of two T-38 units. The design was planned with the intention that the boat should be capable of remaining at sea for several days, and accommodation is appropriate to this need.

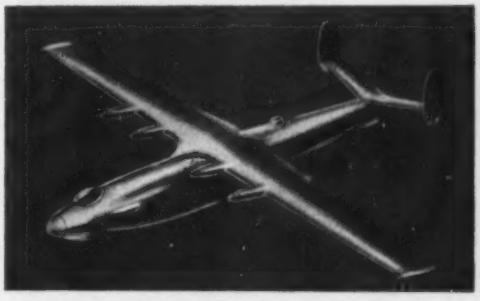
Details of performance are restricted but there is no reason to doubt the makers' picturesquely phrased claims for this 60-ton boat—that it "can skim out of the water in less than 30 seconds with a full load, climb faster than some World War II fighters, and race across the sky at a speed in excess of 350 m.p.h." Armament can include bombs, torpedoes, mines, rockets and other weapons of a secret nature, and for defence there are four laterally disposed barbettes and a tail turret, all with 20 mm guns.

S.N.C.A.N. 1401 (France), with Bristol Hercules engines.

This fine Convair boat is somewhat similar in concept to that proposed by Mr. Henry Knowler, director and chief designer of Saunders-Roe, Ltd., in his recent Blériot Lecture. This design, illustrated herewith, would have a gross weight of 150,000 lb and would cruise at 400 m.p.h. for a gross range of 8,000 miles. It is foreseen that such a craft would exploit new methods of submarine detection, in addition to radar and sonobuoys. For example, it might alight at sea, lie to a sea anchor, and utilize sub-surface methods.

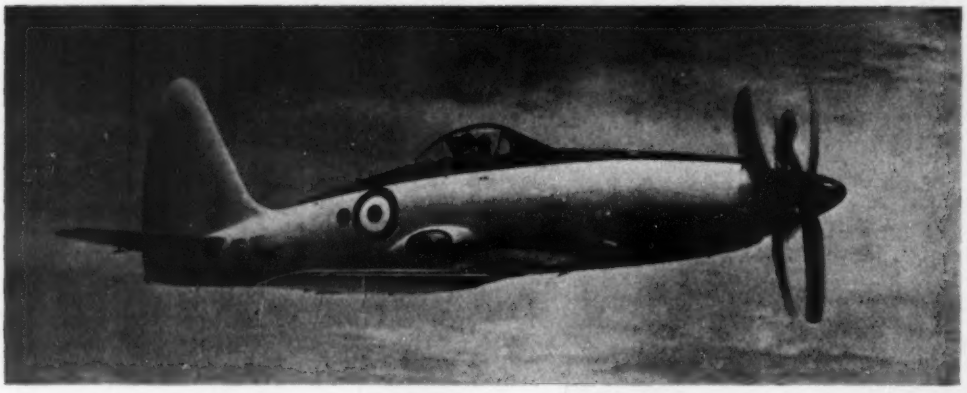
A somewhat similar proposal has been made by Short Bros. In this the hull would be about 110ft long and the radar nacelle might be situated in the hull, aft of the step and clear of the waterline. It could be retracted when not in operation. Armament would be disposed in bow, stern and mid-upper hull positions, and torpedoes or bombs might be carried in the hull, from which location they would be transferred to launching position by specially developed methods.

Meanwhile the aged (though still remarkably efficient) Short Sunderland gives faithful service to the R.A.F.



Recent Saunders-Roe proposal for long-range ocean-patrol boat.

Below: Martin design-study for a large, high-speed, pure-jet flying-boat.



A fast, powerful, single-seat strike fighter on order for British Naval Aviation is the Westland Wyvern, with Armstrong Siddeley Python turboprop.

CARRIER-BORNE STRIKE

THIS class has lost none of its importance, though it must be admitted that its present status in British Naval Aviation might suggest that this was so. The machines it embraces are entering a particularly interesting phase of development, for the first pure-jet designs are materializing, whereas the most advanced machines of the category have hitherto had turboprops or piston engines.

Strike weapons—the torpedo, bomb and rocket projectile—remain little changed in essentials, though it is certain that new forms of torpedo are being perfected which will greatly improve the expectation of success with this weapon. Bombs, which continue in most cases to be externally stowed, are being specially streamlined.

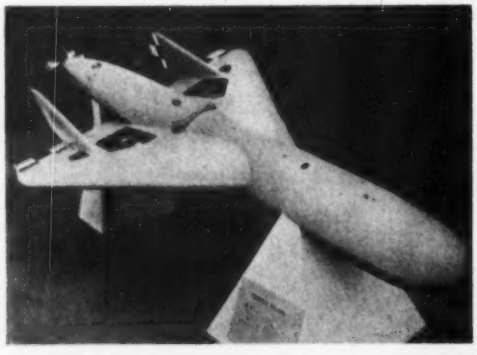
That it is very necessary to keep alive the technique of torpedo-dropping was averred by the Fifth Sea Lord a year or so ago; he added that the Westland Wyvern, with Armstrong Siddeley Python turboprop, would meet most requirements. The Wyvern is a massive single-seater and carries, as shown here, 16 R.P.s in addition to a torpedo. Even with this load it displays a very high standard of manoeuvrability and climb, and is obviously fast, though how much better it is in this respect than its 455 m.p.h. piston-engined Mk 1 precursor may not be divulged. The wings which house four 20 mm guns, can be hydraulically folded to a width of 18ft. Beneath each there is provision for the rockets, bombs, depth charges or extra tanks.

Pending the introduction of Wyverns into British naval service, Blackburn Firebrands continue to operate in the strike role. The Firebrand is a Centaurus-powered single-seater with a top speed of about 340 m.p.h. when carrying its torpedo.

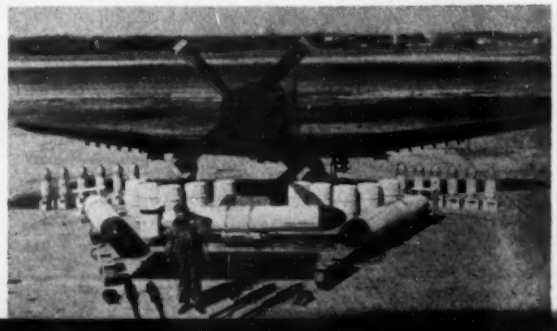
Standard strike equipment in the U.S. Navy is the Douglas Skyraider, developed in several variants but typically a single-seater with a Wright Turbo-Cyclone piston engine. The Skyraider is remarkable for its adaptability and load-carrying possibilities: in Korea machines of this type have been delivering lethal loads of up to 8,000 lb against the Communists. A design feature of unusual interest is the trefoil type of dive-brake, the "leaves" of which are hinged to the sides and bottom of the fuselage.

The newest model of the Skyraider—the AD-5—has been developed to take the utmost advantage of the exceptional versatility of the design; thus, it can be swiftly transformed into a passenger or assault transport, ambulance, day or night striker, anti-submarine hunter/killer, early-warning radar, or radar counter-measures, machine, target tug, or reconnaissance aircraft.

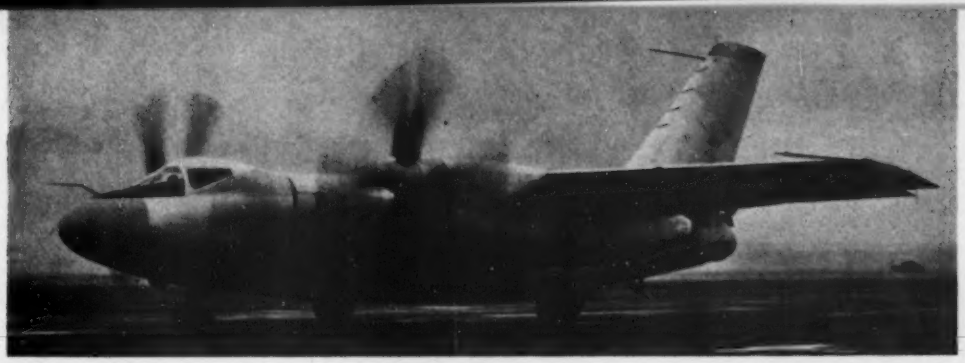
Though bearing a superficial resemblance to the Skyraider, the turboprop-powered Skyshark is, in fact, so far advanced in structural and aerodynamic design as to warrant consideration as a wholly new type. The pilot, from his cockpit mounted high above the Allison T-40 power plant, has a quite exceptionally good field of view. As with the Armstrong Siddeley Double Mamba in the Fairey Gannet anti-submarine aircraft, one half of the power plant can be shut down to protract endurance. The top speed is far in excess of 400 m.p.h. and specially streamlined 2,000 lb bombs have accordingly been developed; with these stowed



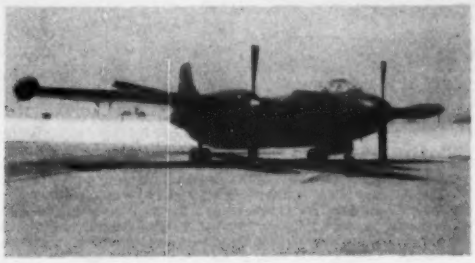
Above is a delta-winged, air-launched torpedo developed by the French Navy; it glides towards its target and sheds its wings on contact with the water. Below, a Wyvern is seen with its torpedo and 16 rockets.



Representative loads of bombs, depth charges and torpedoes arranged before a Martin Mauler, a counterpart of the Douglas Skyraider. In the foreground are the four 20 mm guns with their ammunition supply.

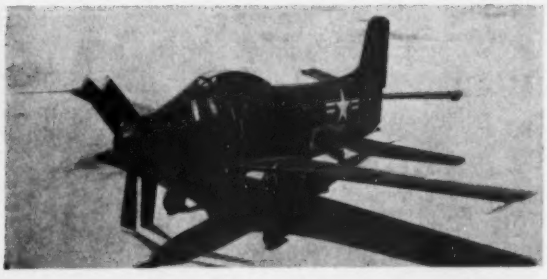


North American XA2J-1 Savage, with two Allison T-40 turboprops—a development of the AJ-1 Savage depicted below.



AJ-1 Savage (two Double Wasps and one Allison J-33 turbojet).

Douglas XA3D, with two Westinghouse J-40 turbojets in "pods."



externally the Skyshark is said to be 50 knots faster than with three bombs of standard pattern similarly disposed.

It was remarked on the introductory page that credit is due to America for having developed a new class of heavy carrier-borne attack machines. Two examples are extant, both of them being North American products. The first, designated AJ-1 Savage, has a composite power plant comprising two Pratt and Whitney Double Wasp piston engines and an Allison J-33 turbojet. Three carriers of the 45,000-ton *Midway* class have all been operated with these machines, and the type has been serving in the Mediterranean for some months. Gross weight is unofficially reported as 55,000 lb and there is pressurized accommodation for a crew of three.

Bearing the same relationship to the AJ-1 Savage as the Douglas Skyshark bears to the Skyraider, the second type (XA2J-1) is powered with two Allison T-40 turboprops driving six-blade contra-rotating airscrews. The gross weight has been raised to over 26 tons and, like the AJ-1, the XA2J-1 will carry an atom bomb in lieu of a 10,000 lb load of conventional bombs. The mainplanes fold inboard and the swept fin folds down.

Even this new version of the Savage is less advanced in design than the Douglas XA3D swept-wing pure-jet machine illustrated on this page in model form. It will be seen that the Westinghouse J-40 turbojets are in underslung pods, like those of the Boeing B-47. The fuselage is bigger and the bomb bay more capacious than the Savage's; nevertheless a top speed in excess of 600 m.p.h. seems feasible. It has been unofficially reported that the gross weight is about 65,000 lb and the entry speed into arrester wires 90 knots. The machine is further interesting in that the same basic design has been adopted by the U.S.A.F. under the designation RB-66, for service in the bomber reconnaissance rôle.

Finally, reference may be made to a French prototype—the Bréguet Type 96 Vultur—which is of unusual interest in that it has an Armstrong Siddeley Mamba turboprop in the nose and a Hispano-Suiza Nene turbojet in the tail. A two-seater, its maximum speed should be far in excess of 500 m.p.h., and with the Mamba only in action it should be able to cruise for 4 hr at an economical speed of about 230 m.p.h. At the time of writing prospects for series production of the Vultur appear slender, which is regrettable, for such a machine should prove valuable not only for anti-shipping strikes, but for intruder work also.

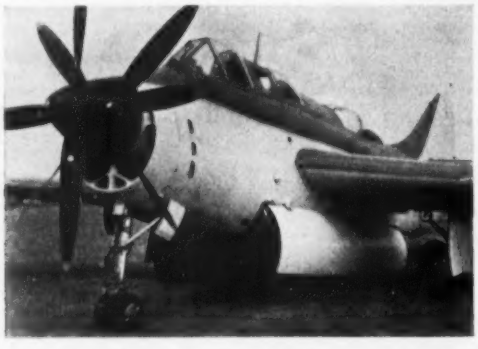
Although it appears that the three aircraft illustrated on the left are all single-engined, this is not, in fact, the case. True, the Douglas Skyraider —seen leaving the U.S.S. "Valley Forge" with three 2,000 lb bombs— does have a single Wright Cyclone piston-engine; but, the Skyshark seen below it is powered with an Allison T-40 turboprop, which consists of two separate T-38 units. Finally, there is the Bréguet Vultur, with an Armstrong Siddeley Mamba turboprop in the nose and a Rolls-Royce Nene turbojet mounted aft.

A prototype of the Fairey Gannet, showing dispositions of the cockpits, retractable radome, and installation of the Armstrong Siddeley Double Mamba.

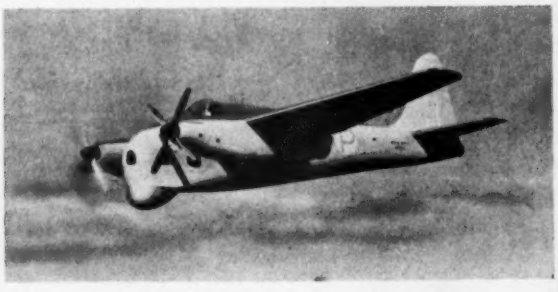
FOR the hunting and "killing" of submarines at sea a distinct new class of carrier-based aircraft is being evolved, and the machines which comprise it are sufficiently important to warrant separate consideration. They must be able to operate from the smaller classes of aircraft carrier, even in dirty weather, have a long endurance at low altitudes, provide for a crew of two to four, and be capacious enough to accommodate bulky and heavy detection equipment and special weapons.

In no fixed-wing aircraft do these exacting requirements appear to have been met with more ingenuity and to better effect than in the three-seater Fairey Gannet, now in production for anti-submarine squadrons of British Naval Aviation. The Gannet was literally designed around the Armstrong Siddeley Double Mamba turboprop, driving co-axial airscrews, and notwithstanding the usual development "snags," this courageous combination of a wholly new power plant with an equally new airframe has proved a harmonious one. The selection of the turboprop power plant was made primarily to conform with the Admiralty's policy of avoiding the storage of petrol aboard carriers, and the particular "double" configuration was dictated by the prohibitive rise in specific fuel consumption of a normal single-unit gas turbine with throttling: thus, in cruising flight one "half" of the Double Mamba is shut down while the other is run at a high (and therefore

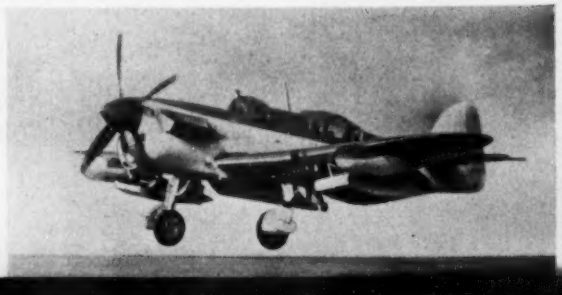
Blackburn and General Aircraft Y.B.1, a counterpart of the Fairey Gannet.



The bomb bay of the Gannet may be contrasted with the external stores (250 lb depth charge and sonobuoys) seen below on a Firefly.



Above Short S.B.3, with two Mamba turboprops. Below is a Firefly Mk. 7, showing a sonobuoy containers, R.P.s, radome and tank.



efficient) power condition. Among the incidental advantages of the gas turbine is that it solves the flame-damping problem. Noise level is relatively low, and radio and inter-communication systems are therefore more efficient. Vibration is also low and the serviceability of instruments, radar and radio are correspondingly improved.

The only major compromise in the design of the Gannet is seen in the positioning of the radar. Ideally this would be in the extreme nose of the aircraft and would necessitate a conventional twin-engine arrangement; in point of fact, it is mounted retractably at the rear end of the bomb bay—the only location possible. Strike weapons—some of a secret nature—are stowed in the bomb bay, and sonobuoys and other service loads can be disposed under the wings.

Built to meet the same requirements (as laid down in the G.R.17 specification) the Blackburn and General Aircraft Y.B.1 is similarly powered and is likewise notable for ingenuity of design and excellent performance. The S.B.3 is a development of the Sturgeon, with two Armstrong Siddeley Mambas, and differing further in that complete nose section has been redesigned to house additional crew members and search radar.

Pending the introduction of the Gannet into Royal Naval service, a quantity of Firefly Mk 7s will be delivered. It should be explained that whereas anti-submarine duties occasionally fell to the lot of earlier marks of Firefly, the Mk 7 has been developed specifically for the work. Like the Gannet, it is a three-seater; no guns are carried but there is external stowage for sonobuoys and offensive weapons. The radio and radar are officially described as being "appropriate for the latest anti-submarine detection devices."

At the last Farnborough Display a prototype of the Firefly 7 appeared with large containers slung beneath the wings, inboard of the radar housing and auxiliary tank, and it was disclosed that these were heated sonobuoy containers—for the delicate transmitters in the buoys demand warmth. On that particular machine eight R.P.s were carried inboard of the containers.

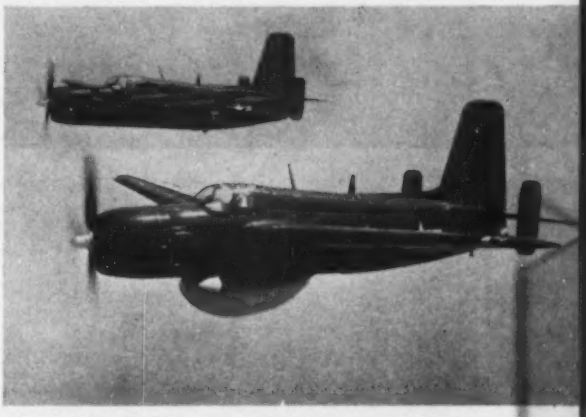
Certain basic differences distinguish the Grumman AF-2 Guardian, nearest American counterpart of the Gannet described earlier—notably that the power plant is a piston engine (Pratt and Whitney Double Wasp). Of the Guardian there are two distinct versions, and one of each—a hunter (AF-2W) and a killer (AF-2S)—work together in pairs. On the hunter a massive radome, housing search equipment, is located under the cockpit. With this installed no armament whatsoever is carried, but the killer variant has internal stowage for a variety of weapons, including guns (2 × 20 mm), torpedoes, depth charges and bombs. Other loads can be slung beneath the wings in addition to a searchlight and a radar scanner.

The hunter carries a crew of four—pilot, co-pilot and two radar operators—whereas the killer is manned by only three men, namely, pilot, navigator bomb-aimer and radar operator. Notwithstanding its bulk (the span is 60ft and the gross weight 25,000 lb) the Guardian has a maximum speed of over 300 m.p.h. in the clean condition. Endurance and slow-flying characteristics are reported on favourably.

In spite of the high efficiency shown by fixed-wing aircraft like the Fairey Gannet and Grumman Guardian, there is no longer any doubt that such machines may eventually be largely, if not wholly, superseded by helicopters. These, of course, would not demand special aircraft carriers for their operation for they could work from the decks of merchant ships. They would be developed for all-weather flying and should be ideally suited for the utilization of special detection apparatus. In this connection it was disclosed early this year that a new device, known in the U.S. Navy as the "sonar ear," has been tested in North Atlantic trials. Lowered into the water while the helicopter carrying it hovers at about 50ft over a suspected area, it is capable of detecting submarines at well below periscope depth, and three or four helicopters, working as a team over a wide area, could quickly pin-point a submerged craft.

Details of British experiments may not be divulged, though it is known that both the Bristol Sycamore and Westland-Sikorsky S-55 have been utilized in anti-submarine trials. In his lecture *Military Aspects of the Transport Helicopter*, delivered last August, Mr. F. N. Piasecki expressed the pride of his company in the fact that their HUP-2 helicopter had been selected as the standard anti-submarine helicopter of the U.S. Navy. A large portion of the Piasecki helicopter programme has, in fact, resulted from tests by the United States Navy near Key West, wherein a helicopter was studied as an aerial platform from which submarines could be hunted and attacked. Mr. Piasecki mentioned mine clearance as a secondary function.

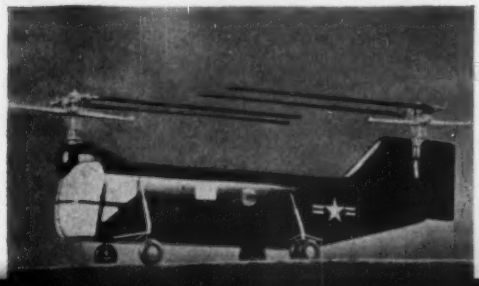
The tandem-rotor HUP-1 has folding bladed and, with a Continental nine-cylinder engine of 525 h.p., achieves a maximum speed of 117 m.p.h. and an initial rate of climb of 1,200ft min. It is already in service. A somewhat similar, but larger, machine, the Bell XHSL-1, will have a Double Wasp engine.

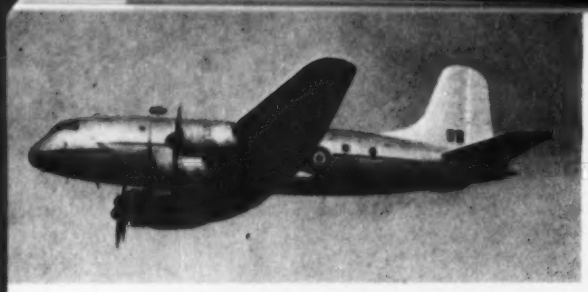


A hunter killer team of Grumman Guardians (hunter nearer camera).

Above: The AD-5 version of the Douglas Skyraider, adaptable for anti-submarine warfare. Below are Piasecki HUP-2 anti-submarine helicopters.

A model of the Bell XHSL-1 (P. and W. Double Wasp) anti-submarine helicopter designed for the U.S. Navy. The blades are shown folded.





Handley Page Hastings (four Bristol Hercules).

TRANSPORTS

AMONG the heterogeneous collection of military transport aircraft now at large many of the types are of civil origin, though it is apparent that increasing emphasis is being—indeed must be—placed upon specialized military requirements, particularly in the matters of dimensions and loading facilities. Primarily this is due to repeated solicitations from the ground forces concerned, but also to a growing realization that multiplicity of types can be especially uneconomical in the transport field. But whatever rationalization may eventually be effected, several different classes must remain, some with fixed, others with rotating, wings.

Though represented on a semi-experimental basis by the Convair XC-99 and Lockheed Constitution of the U.S.A.F. and U.S. Navy respectively, the very largest types of military transport aircraft are not in general service, partly due to their costliness but also because their true potentialities cannot be realized with piston engines. The XC-99 is the world's largest landplane and is the transport counterpart of the B-36 bomber. There are two decks and the greatest cargo load carried to date is in excess of 101,000 lb. The total usable volume of the fuselage is about 30,000 cu ft. Plans for a turboprop development of this type are not known to have received official recognition.

Pre-eminent among the large long-range machines now actually in operation with the U.S.A.F. is the Douglas C-124 Globemaster II, with four Wasp Major piston engines, and this type is known to equip at least three strategic support squadrons and one troop-carrier squadron. Though designed for a gross weight of 175,000 lb, the Globemaster II has successfully taken off at a weight of 194,500 lb, at which weight a payload of about 50,000 lb may be carried for more than 2,500 statute miles with "adequate fuel reserves." Over lesser distances the load can be increased to more than 70,000 lb. Developed from the earlier Globemaster I to carry troops, general cargo, tanks, guns, bulldozers, trucks, etc., the C-124A has nose-mounted clamshell doors providing an opening 11ft 8in high and 11ft 4in wide, which is used in conjunction with a built-in ramp. Usable cargo space is more than 10,000 cu ft. A spokesman of the Douglas company has stated that a fleet of 80 of these machines could transport a division of 16,000 armed men from Massachusetts to the vicinity of Brest, in France, with two refuelling stops en route. Another 80 could move 2,500 tons of divisional equipment over the same route. A turboprop development, the YC-124B, should fly shortly and will have greater speed and lifting capacity.

Impressive as the above figures are they are less significant than those quoted last year for the Saunders-Roe Princess flying-boat, originally designed for civil operation, then destined for Transport Command, but now in abeyance. The claim is confidently advanced by the constructors that three Princesses could, by virtue of the time saved by air travel, as compared with sea transport, carry in one year as many troops as could be ferried by nine ordinary troopships on strategic trooping routes.

It is a pointed commentary on the present state of military transport flying that, whereas the Princess was designed for commercial use, a smaller American counterpart, built by Convair, was primarily intended for long-range maritime reconnaissance, and as such, under the designation XP5Y-1, figures under the appropriate heading.

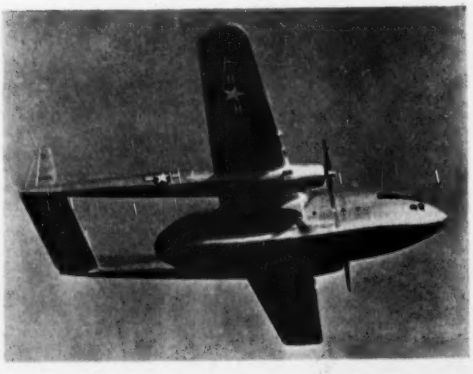
Military versions of the Boeing Stratocruiser, Lockheed Constellation and Douglas DC-6 are all rendering excellent service, and turboprop developments for the U.S.A.F. and U.S. Navy are in hand. The U.S. Navy's Super-Constellations, with four Pratt and Whitney turboprops, are expected to cruise at speeds approaching 400 m.p.h. at 25,000ft.

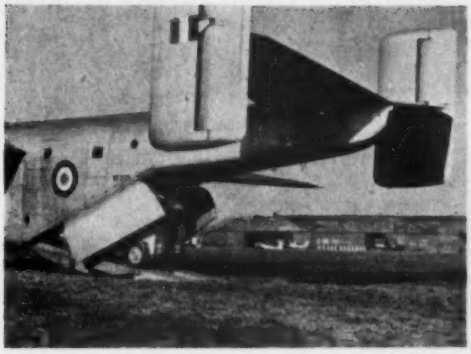
Vickers-Armstrongs Valetta (two Bristol Hercules).

Blackburn and General Aircraft G.A.L. 60 (four Hercules).

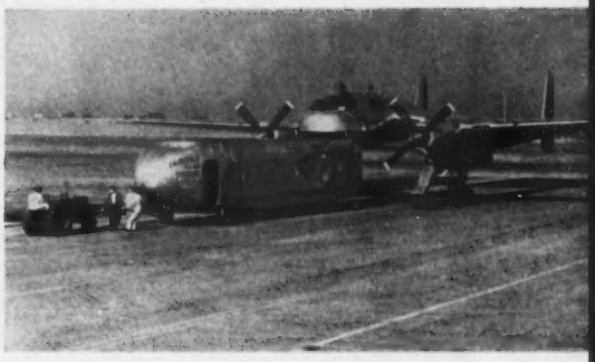
Below: Fairchild XC-120 Pack Plane (two Wasp Majors).

Below: Fairchild C-119 Packet (two Wasp Majors).

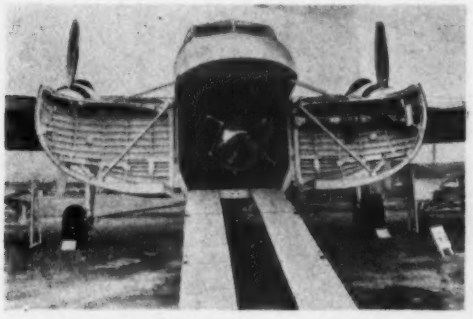




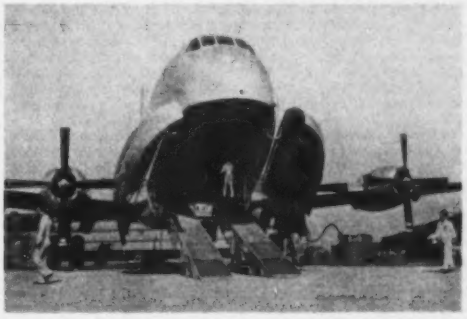
Bus emerging from Blackburn and General aircraft G.A.L. 60.



Unshipping "pack" from Fairchild XC-120.

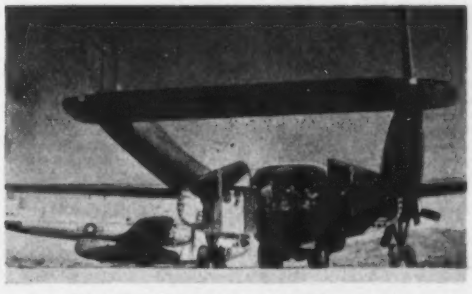


Bristol Sycamore helicopter loaded in Bristol Type 170.



Nose doors and loading ramp of Douglas C-124A.

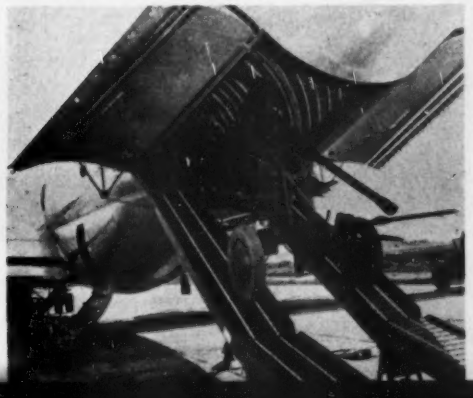
Chase XC-123 taking five jeeps aboard.

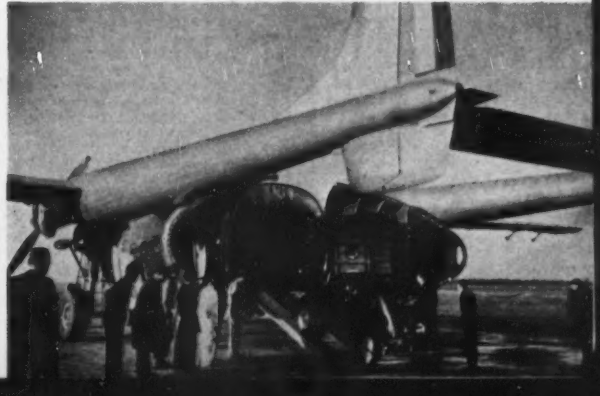


Fairchild C-119 Packet being loaded from a truck.

Bofors 40 mm gun on ramp of Boeing C-97 Stratofreighter.

S.N.C.A.N. 2501 Noratlas with car going aboard.





TRANSPORTS

One of the most promising of projected military transports, for which a U.S.A.F. contract has been placed with Lockheed, is a freighter designed to take four Allison T-38s; it will have rear loading doors and the floor will be only 45in above the ground. The Fairchild concern, which has achieved a unique success with its Packet series, is also working on advanced designs to take turboprop power; in the meantime, the latest Fairchild developments which can be named are the XC-120 Pack Plane, incorporating a detachable main-cargo compartment (as on certain Miles designs which materialized in England soon after the war) and a long-span Packet development designated C-119H. Indicative of the potentialities of the standard C-119 Packet is the dropping by parachute of a 9½-ton bulldozer.

In the "assault transport" role—that is, for the air-lifting of troops and equipment to unprepared terrain in the combat zone, or even into the heart of a land battle—a modified C-119 was subjected to competitive tests but was rejected in favour of the Chase C-123 Avitruc, shown on page 413. This machine has the unique distinction of having been flown as a glider, with piston engines and with turbojets. At first it appeared that no operational role was foreseen for the pure-jet development, but Mr. Stroukoff, the designer, is reported as having predicted a "great future" for it.

In the Handley Page Hastings and Vickers-Armstrongs Valetta the R.A.F. has a four-engined and a twin-engined type of good performance, though each is handicapped for certain classes of work in that loading is possible only from the side. Unlike certain air forces overseas, the R.A.F. has not adopted the Bristol Type 170 which, though it has the invaluable advantage of nose-loading facilities, nevertheless lacks the means of parachuting or otherwise unloading bulky loads astern. This possibility is a particularly appealing feature of the Fairchild Packet and a French imitation, the Hercules-powered Noratlas, now in series-production for l'Armée de l'Air. Russian military transport squadrons are equipped with twin-engined Il-12s—undistinguished in any respect—and possibly a transport version of the Russian-built B-29.

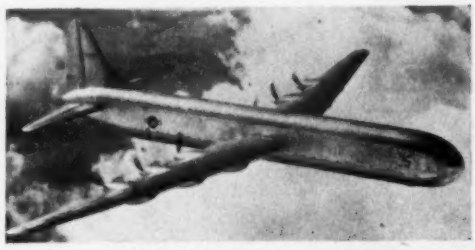
Supreme among short-range, high-capacity military transports is the Blackburn and General Aircraft Universal Freighter, the Hercules-powered prototype of which is known by repute throughout the world though only the single example has yet flown. It was recently disclosed that an order has been received from the Ministry of Supply for the completion of the second—Mk 2—version, powered with Bristol Centaurus engines and having an improved rear fuselage to facilitate the handling of bulky cargo. While retaining the remarkable take-off and landing characteristics of its lower-powered precursor, the Mk 2 will lift a payload of 20 short tons and will cruise at 225 m.p.h. With its excellent landing and take-off characteristics and bogie undercarriage the MK. 2 will still be able to operate from secondary airfields.

Helicopter transport on a respectable scale may be said to have originated with the introduction of the larger types of Piasecki and Sikorsky. In this sphere, as in communications and general-utility flying, rotary-wing machines hold promise of remarkable economies. It has been estimated by Lt.-Col. C. W. Matheny, U.S. Artillery, that 105 helicopters (payload about 3,500 lb; cruising speed, 100 m.p.h.) could move some 2,500 tons of provisions (five days' supply for a division) a distance of 60 miles in 24 hours. Between the same two points (estimated road distance 80 miles) 105 2½-ton trucks could move some 1,000 tons (two days' supply for a division) in the same 24 hr period. Improved helicopters with a payload of about 4,500 lb could move about 3,500 tons. Thus, as a rule of thumb it could be said that it would take about three trucks to move as much as one helicopter, of similar capacity, when performing short-haul tasks in areas where adequate roads were available and the ultimate destination was accessible to road vehicles.

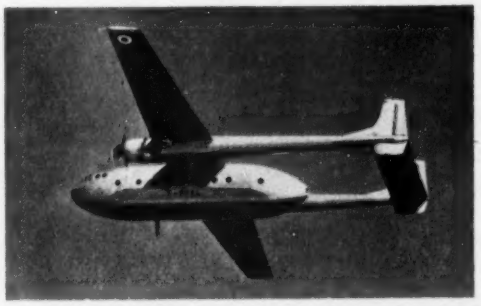
Representative of the large transport helicopters now under development in America is the Piasecki XH-16, designed to carry three tons of cargo or 25 troops, and equipped with a detachable "pack." This type will be further developed, possibly with turboprop power, for a payload of about five tons, which is considered by the U.S. Army to be the most practical for supplying troops in forward areas. The experimental Hughes XH-17 jet-driven helicopter has a designed payload of 9,000 lb, and specifications for a successor to this type are reported to call for a 28,000 lb payload and a 350-mile range.

Douglas C-124A Globemaster II (four P. and W. Wasp Majors).

Boeing C-97A Stratofreighter (four P. and W. Wasp Majors).



Consolidated-Vultee XC-99 (six P. and W. Wasp Majors).

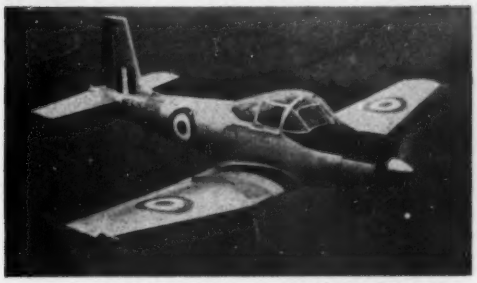


S.N.C.A.N. 2501 Noratlas (two Bristol Hercules).

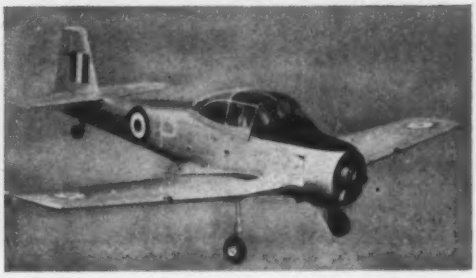
Sikorsky HRS-1 (Pratt and Whitney Wasp).

de Havilland Chipmunk (D.H. Gipsy Major).

Percival Provost (Alvis Leonides).



Handley Page H.P.R.2 (Armstrong Siddeley Cheetah).



Commonwealth CA-22 (P. and W. Wasp Junior).

TRAINERS

THE ending of the war left the air-training fields of the Powers packed with mass-produced aircraft. There were the light tandem-seaters typified by the D.H. Tiger Moth, Miles Magister, Fairchild Cornell, etc.; more advanced machines such as the Harvard and Master; and twins like the Oxford, Anson, and various Beechcrafts. For the most advanced work adaptations of operational types gave adequate service.

Though it continued to be necessary to employ as much of this equipment as possible, compatible with safety and efficiency, peace brought a fuller opportunity for a radical examination of training requirements; this, indeed, was rendered imperative by the introduction of jet-propelled fighters. Theories were expounded on all sides. New specifications were issued, only to be drastically modified; but no vital changes occurred. True, in the R.A.F. new formulae were introduced: for instance, the three-seat primary/basic Percival Prentice was adopted by the R.A.F. and the pattern of the Prentice—dictated by economy—was imitated elsewhere. But though some hundreds of Prentices were built, the type is shortly to be superseded by the two-seater Provost, of higher power and, as will later be seen, differing considerably in make-up. The Provost is truly a "basic" type, while "primary" (*ab initio*) instruction is the declared function of the tandem-seat de Havilland Chipmunk. "Advanced" training falls to the Boulton Paul Balliol, and jet conversion to the Gloster Meteor 7 and de Havilland Vampire T.11, while as flying classrooms and for more specialized forms of instruction various twin-engined types are being taken into service.

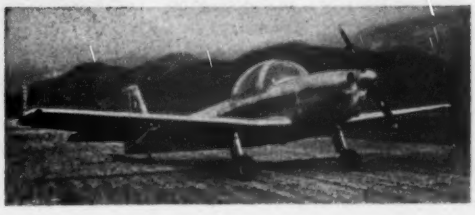
Training requirements do not appear to have been foreseen and stated with any greater clarity in America than in this country or elsewhere, though in general it may be said that the primary class, as we ourselves know it, remains out of favour. In brief, the declaration in the preceding review of this series—that, inasfar as it has been formulated at all, future design and development policy is in many respects obscure—holds good today. It is,

Fokker S.11 Instructor (Lycoming O-435A).

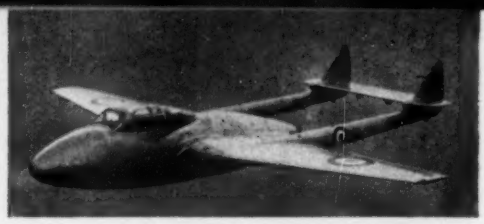
Piaggio P. 148 (Lycoming O-435A).

Morane Saulnier M.S. 730 (Mathis 8G.20).

Fiat G. 46-B (D.H. Gipsy Queen 30).



Gloster Meteor T.7 (two Rolls-Royce Derwents).

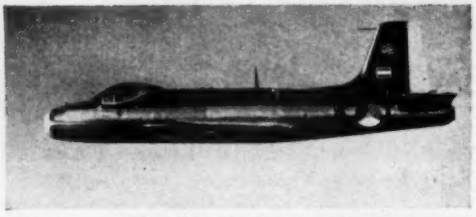


de Havilland Vampire T.11 Trainer (D. H. Goblin).

Boulton Paul P.119 mock-up (R.-R. Derwent).

Fiat G.80 (de Havilland Goblin).

TRAINERS



Fokker S.14 (Rolls-Royce Derwent).

nevertheless, instructive to survey briefly the various classes now in existence, with special reference to the most modern, or otherwise interesting, designs.

Among British (or, more strictly, Commonwealth) types, the Canadian-designed tandem-seat de Havilland Chipmunk, typically with Gipsy Major engine, is familiar enough to obviate further reference. A less well known, less orthodox, but strictly comparable "primary" design is the Auster Aiglet Trainer, of reduced span compared with the A.O.P.s to which it is related, and, of course, fully aerobatic.

The great majority of foreign machines designed for primary work are of higher power, though there are exceptions, like the Argentine Colibri and Hindustan HT-2, with Cirrus Major engine. In general, American primaries have more than 200 h.p. and representative of these is the tandem-seat Beechcraft Mentor, with 225 h.p. Continental flat six. The speed range is 55-190 m.p.h. It may be noted that, though various primary designs of post-war origin have been tried out by the U.S.A.F., no orders have materialized, though one—for the Fairchild T-31—was placed; instead, hundreds of North American Texans (Harvard type) are being refurbished. The engine of the Texan is the 550 h.p. Wasp and, though the machines are being used for primary instruction, equipment is appropriate to the "basic" category.

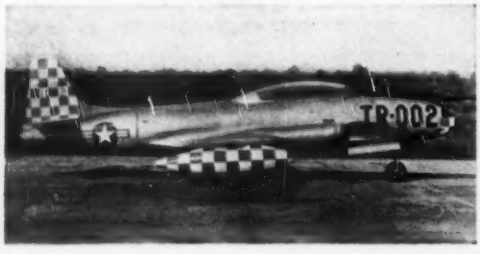
As already remarked, the R.A.F. fostered, as an economy measure, the relatively low-powered three-seat basic formula (Percival Prentice) and a similar solution was taken up abroad, notably in France and Italy. But, with the lapsing of the formula in its country of origin, European designers have modified their own thinking accordingly. Nevertheless, the Piaggio P.148, which is particularly noteworthy for the standard of its design and construction, retains the "occasional third" seat. This design was hastily got out to convince the Italian government that it was unnecessary to build the excellent Fokker S.11 under licence. The Italians, incidentally, still favour the "aerobatic" trainer, and appealing examples are the Ambrosini S.7 and the single-seat version of the Fiat G.46, both with inverted six in-line engines.

A basic trainer which demands special mention, in that it has been chosen to re-equip all R.A.F. Flying Training Schools, is the Percival Provost, with Alvis Leonides engine. Here it may be remarked that the Leonides seems assured of extensive employment in the training field; among other concerns, Fiat has a new trainer design (G.49-1) to take this highly efficient British power unit.

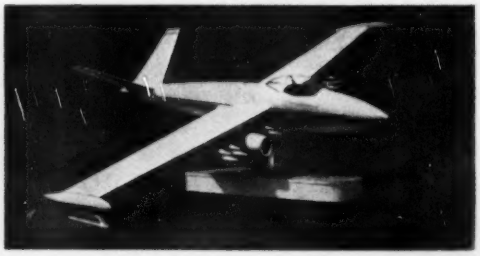
For more advanced tuition, though of earlier design, the Merlin-engined Boulton Paul Balliol and Sea Balliol and the North American T-28A are being taken into service by the R.A.F. and U.S.A.F. respectively. But whereas the Balliols retain the tail-down undercarriage, the American machine, which has a 700 800 h.p. Wright Cyclone engine, is of nosewheel type; it has a speed range of 72-288 m.p.h. and, like the Balliol, has provision for armament, radio, and full night-flying and blind-flying equipment.

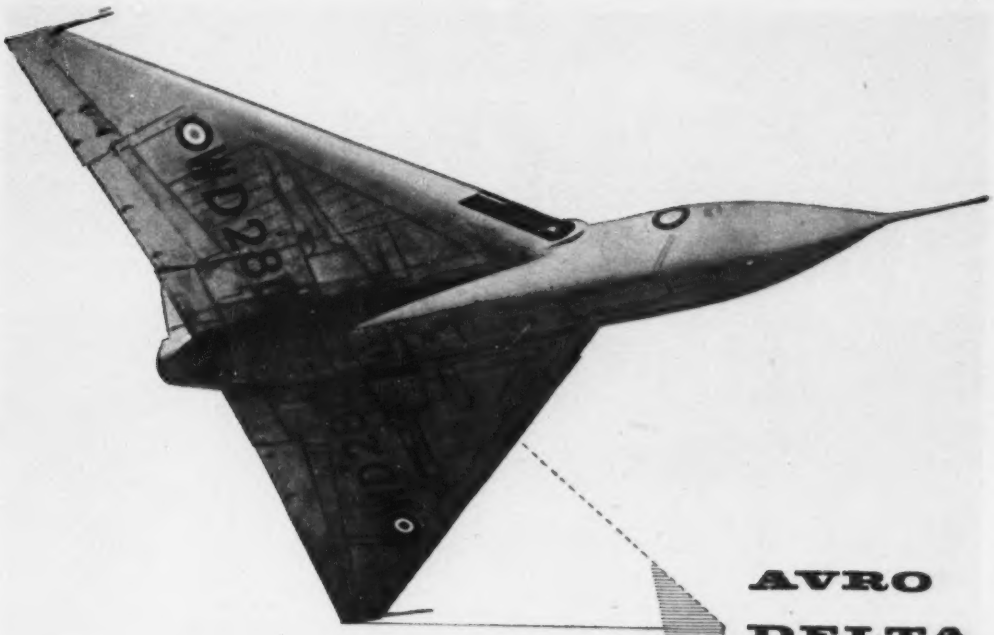
For twin-engined training and instruction in navigational and other techniques new designs are materialising over a wide range of sizes and weights. A new British example is the Percival Pembroke, developed from the Prince and foreseen in several variants. Pending introduction of the type, versions of the Prince and Sea Prince will be available for certain types of tuition. A little heavier than the Prince is Holland's 12,700 lb Fokker S.13 (two Wasps), and larger and more advanced still is the Beechcraft T-36, to be built in Canada and America. The T-36 will weigh about twice as much as the S.13, and with two Double Wasp engines will have a top speed of at least 350 m.p.h. It will be taken into U.S.A.F. service to supplement the Convair T-29A, itself a military crew-training development of the Convair-Liner. Britain's counterpart of the T-29A is the Vickers-Armstrongs Varsity, suitable for training in air navigation and bombing, pilot training, and signals. A companion type, though of less specialised design, is the "flying classroom" variant of the Valetta transport, which may be

Lockheed T-33 (Allison J-33).



Fouga Lutin (two Turboméca Palas).





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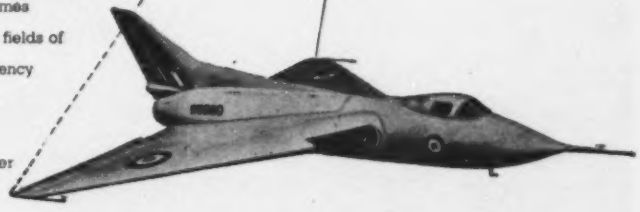

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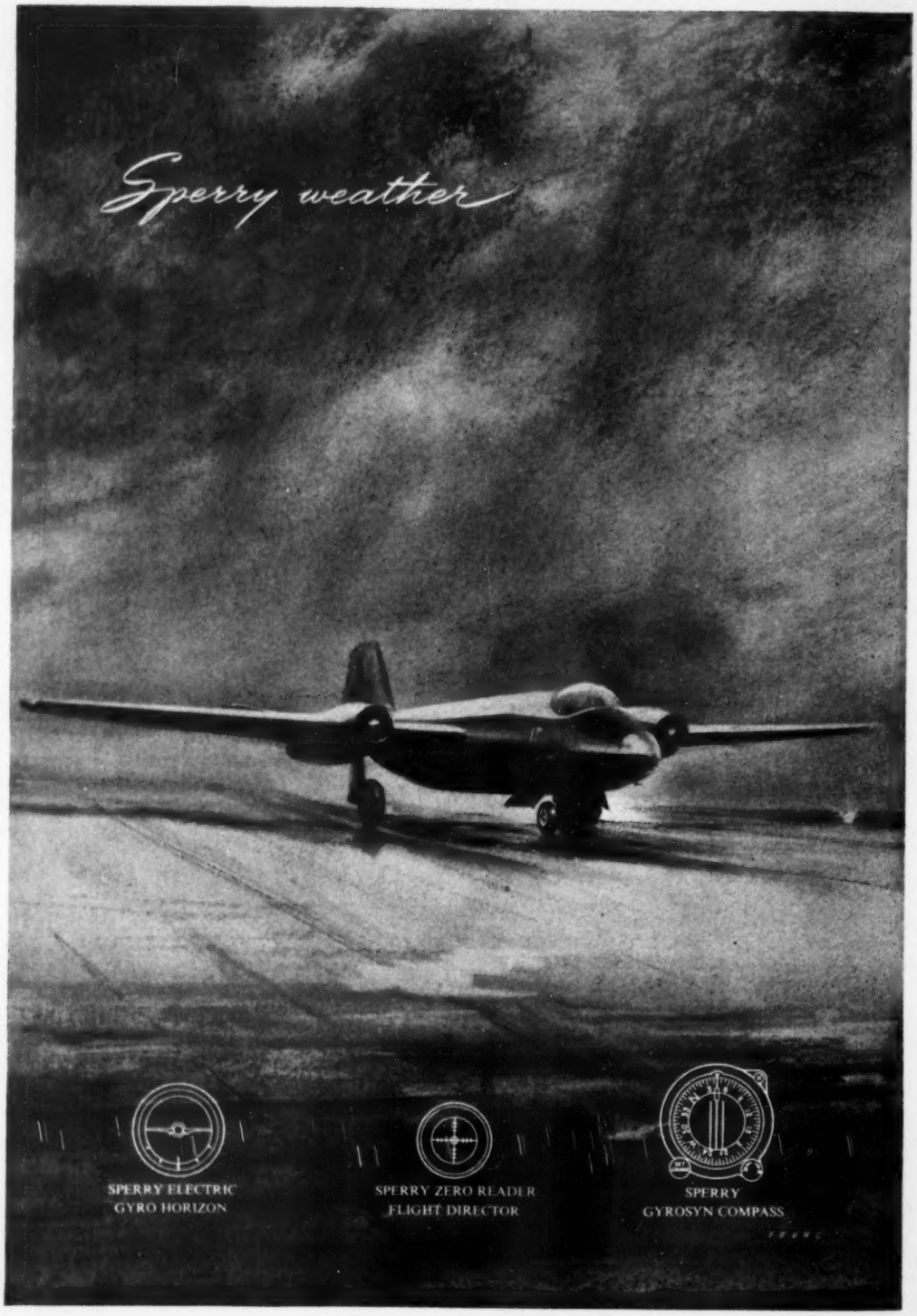
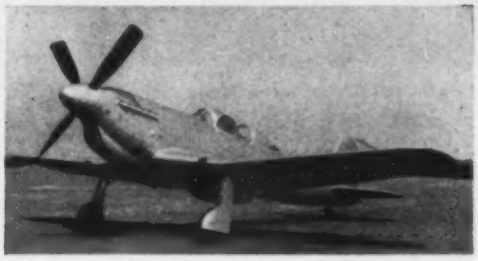

Sperry weather
SPERRY ELECTRIC
GYRO HORIZON
SPERRY ZERO READER
FLIGHT DIRECTOR
SPERRY
GYROSYN COMPASS

Boulton Paul Sea Balliol (Rolls-Royce Merlin).

Hawker Sea Fury Trainer (Bristol Centaurus).

North American T-28 (Wright Cyclone 7).



Fiat G.59/4 (Rolls-Royce Merlin).

distinguished by six astrodromes along the top of the fuselage.

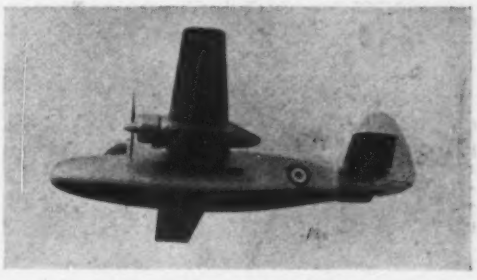
The world's jet trainers are most appropriately grouped according to whether they are conversions of established fighter types or of new, specially conceived, design. In the former category the pre-eminent examples are the Gloster Meteor T.7, de Havilland Vampire Trainer (R.A.F. designation, Vampire T.11) and the American Lockheed T-33 (Shooting Star development). Though the Meteor already has a long and successful tour of R.A.F. duty behind it, the Vampire Trainer is new to the Service. It scores over the Gloster in that it can carry gun or rocket armament—an advantage it shares with the T-33. Furthermore, it should prove considerably more economical in operation, though the Meteor is notably superior in certain aspects of performance. The T-33 has been turned out in very great quantities with the Allison J-33 turbojet, but is now being produced in Canada with a Nene.

Although, as mentioned in the former review, the first jet trainer was France's Nene-powered S.O.6000 Triton, this type was never seriously regarded as a school machine. This, however, is far from being the case with the Fokker S.14 two/three-seater, powered with a Rolls-Royce Derwent and having a maximum speed of about 440 m.p.h. The S.14 is a very capacious machine and though, as will be judged, the performance is only moderate, it should be adequate to meet requirements of the immediate future. A very different approach to the jet-trainer problem is seen in the Fiat G.80, the first prototype of which is now flying with a Goblin 35 turbojet, though the second will have a Nene. Very clean aerodynamic design, excellence of construction, and tandem seating, have contributed to a very high performance (550 m.p.h. with a Goblin), but it must be noted that fighting, as well as training, requirements were in mind when the designs were prepared.

Though of lower performance, the projected Boulton Paul P.119 (Rolls-Royce Derwent) will be a roomier machine with side-by-side seating. Should the ultimate in performance be desired, a Nene can be accommodated and with this unit the speed would rise from 475 m.p.h. at 22,500ft to about 555 m.p.h. at 10,000ft.

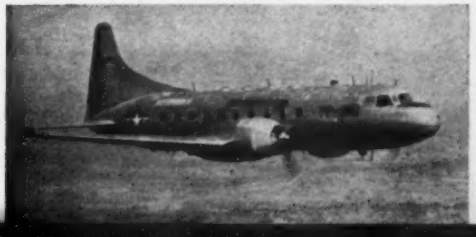
Finally, acknowledgement must be made of France's lead in the development of light, simple, jet trainers, exemplified by the appealing little Fougas, with their low-thrust Turboméca jets.

Vickers-Armstrongs Varsity (two Bristol Hercules).



Percival Sea Prince (two Alvis Leonides).

Convair T-29 (two P. and W. Double Wasps).



Fokker S.13 (two Pratt and Whitney Wasps).

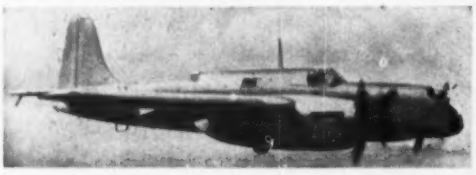
Bristol Sycamore (Type 171), with Alvis Leonides engine.

Westland-Sikorsky Dragonfly (S-51), with Alvis Leonides engine.

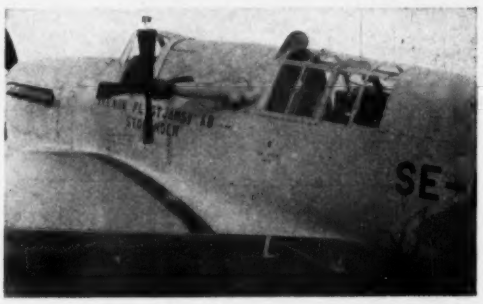
FOR GENERAL DUTIES

PICTURED on this page are various fixed-wing and rotating-wing machines designed or adapted for a wide variety of duties, embracing gunnery training, air/sea and arctic rescue and operational research. The two amphibians illustrated are American, but the smaller British Short Sealand should prove similarly useful in the military field. Tanker aircraft for flight refuelling are generally converted bombers or adapted transport machines. Helicopters are valuable in military service not only in the transport, A.O.P. and liaison rôles, but for cable-laying, rescue, and, when of sufficient lifting capacity, as flying "cranes" for constructional or clearance work.

Hiller 360 (Franklin 6V4 flat-six engine).



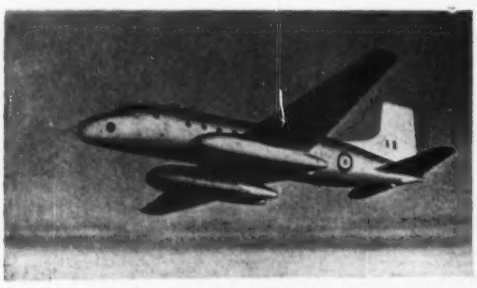
Short Sturgeon T.T.2 target tug (two Rolls-Royce Merlins).



Tow-line winch on Fairey Firefly target tug (Rolls-Royce Griffon).

Arsenal S.501 ramjet-propelled remotely controlled target.

R.F.D. winged target Mk 1, for aerial towing.

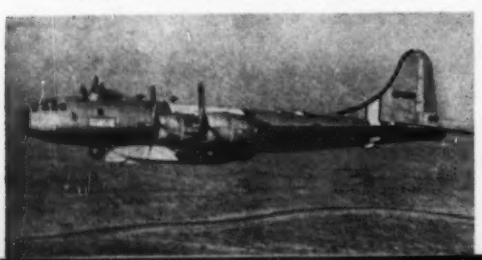


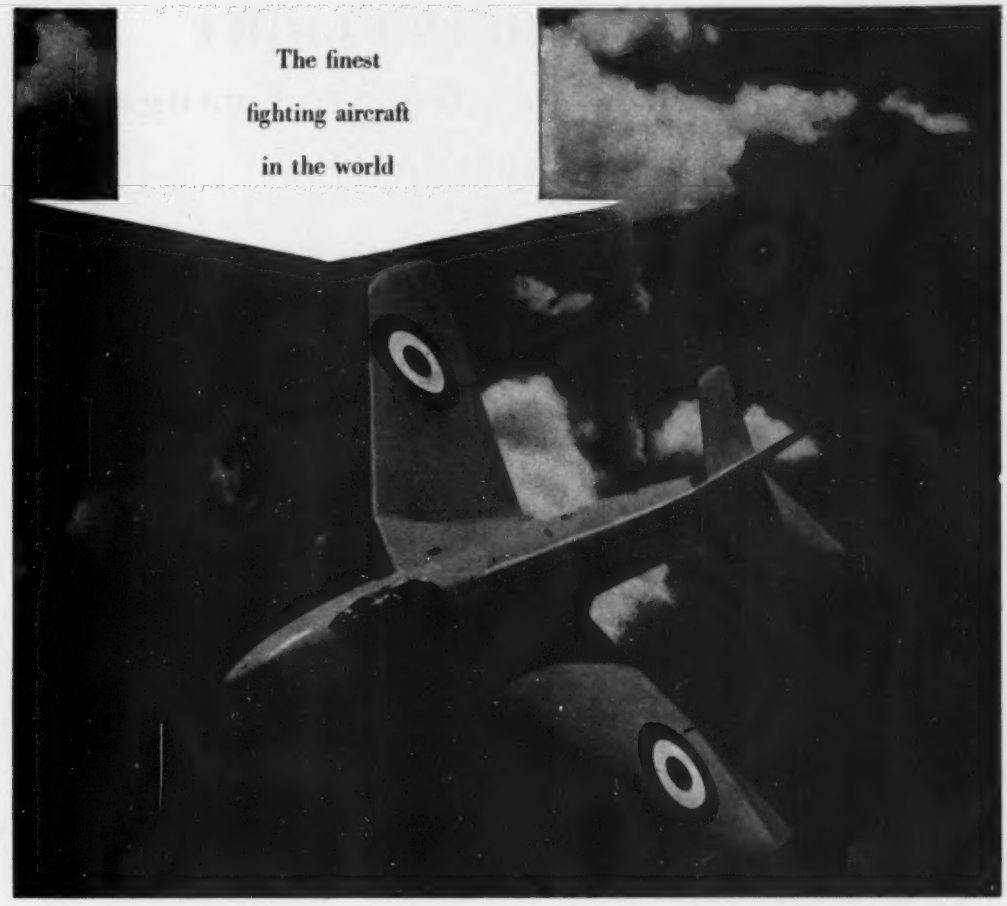
Avro Ashton high-altitude research aircraft (four Rolls-Royce Nenes).

Boeing SB-29, with lifeboat driven by 18 h.p. engine.

Martin PBM-5A amphibian, with Pratt and Whitney Double Wasps.

Grumman SA-16 general-purpose amphibian (two Wright Cyclones).





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Hawker Hunter

The year 1951 saw British aircraft design establish without question the leadership of the whole world. Outstanding, even in a year of such achievement, is the new Hawker Hunter. It is an open secret that this swept-wing fighter, with its beautiful thoroughbred lines, repeatedly set new speed records at the Farnborough 1951 show. Against great competition, it was hailed as the number one star. The R.A.F. ordered the Hawker Hunter for quantity production straight from the drawing board, a well-deserved compliment to the Hawker fighter tradition of Hurricane, Typhoon, Tempest and Fury. Like these famous predecessors, the Hawker Hunter was designed by Sydney Camm.

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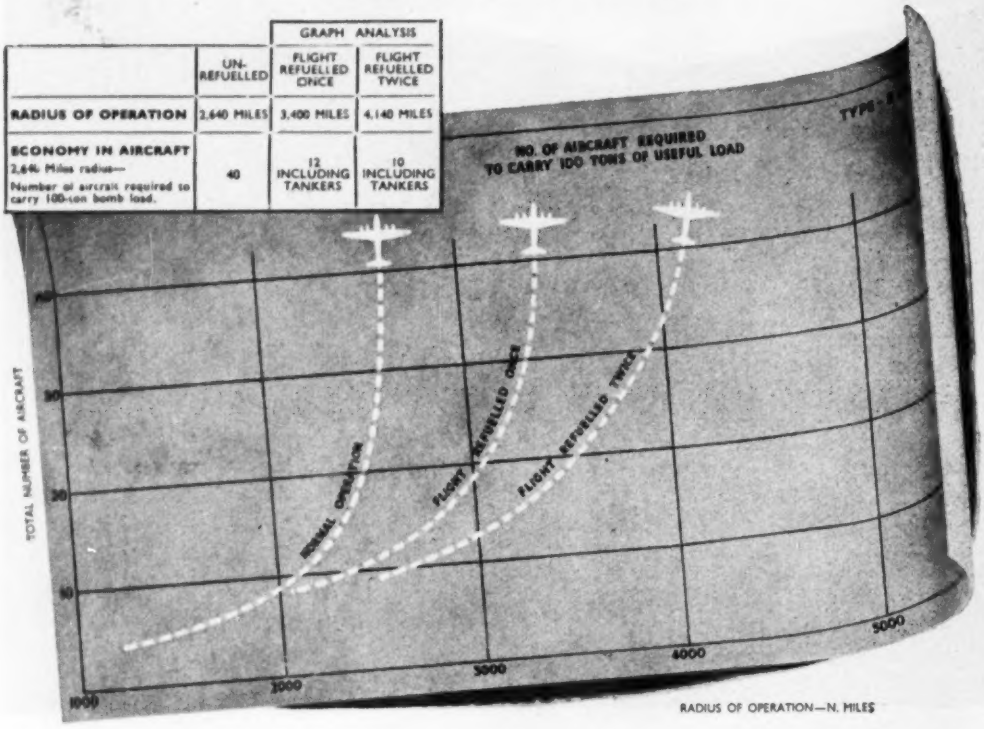

The practical, *immediate* potentialities of refuelling in flight have been demonstrated by the rapid refuelling of military jet aircraft while flying at high speed. Today, highly developed far beyond the experimental stage, flight refuelling is a simple, economical method of substantially improving the range and useful load of both military and civil aircraft. Two vitally important aspects of this question—radius of operation and economy in aircraft—are indicated in the above graph. The advantages of flight refuelling, together with their bearing on present conceptions of effective air power, are strikingly apparent.

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MATUKU MOANA: This Heron, the first production model, is shortly to arrive in Wellington, New Zealand, where it will be demonstrated by the de Havilland Aircraft Company of New Zealand. All the New Zealand National Airways' aircraft bear the Maori names of birds; Matuku moana means heron.

CIVIL AVIATION

T.C.A.'s FIRST OVERALL PROFIT

IN the reports of Trans-Canada Air Lines on their domestic and overseas services for the calendar year 1951, made to the Minister of Trade and Commerce in Ottawa, Mr. G. R. McGregor, T.C.A.'s president, was able to say: "Financially, this was by far the most successful year the company has yet had, but perhaps even more gratifying was the contribution it was able to make to the transportation needs of Canada.

"Volume of business exceeded that of 1950 in all categories with system passenger transportation increasing by 20 per cent, air-cargo and air-express loads by 13 per cent and mail by 11 per cent. Although the traffic trend has been steadily upwards since the Company's inception, in no other year has the extent of the advance been so pronounced.

"General expansion of the Canadian economy, immigration and the ever-widening public patronage of air transportation brought about a marked increase in gross revenues. On the other hand, the increase in expenses was on a very much smaller scale. The logical outcome of these two relatively satisfactory trends was a system surplus of $3,890,957" [£1,389,627].

Operating revenues showed an increase of 16 per cent, while operating expenses were only four per cent higher. The cost per ton-mile in 1951 was reduced from 40.48 cents in 1950 to 37.22 cents.

T.C.A. is now operating transcontinental and transatlantic services, certain regional services in Canada and to the U.S.A. and routes to Bermuda, Nassau, Kingston, Barbados and Port of Spain. The fleet consists of 20 Canadair Four *North Star Skyliners* and 27 DC-3s. In spite of the fact that the utilization of the Canadairs was at the rate of over 9½ hr a day by midsummer 1951, it became apparent that the fleet was not large enough, and three more aircraft of this type will enter service this year. Five turbo-Cyclone Super-Constellations have also been ordered, for delivery next year.

In 1951 T.C.A. flew 3,925,058 aircraft-miles, 94,319,673 passenger-miles, 498,722 mail ton-miles, 1,846,583 cargo ton-miles and a total of 13,345,858 revenue ton-miles; 42,646 passengers were carried.

At December 31st T.C.A. was providing service for passengers, mail and freight over 8,641 miles of North American routes and 8,688 miles of overseas routes. Over the system there was scheduled 65,320 aircraft-miles daily and there were 2,039,157 available passenger-miles. On North American routes 96 per cent of all scheduled aircraft-miles were flown.

AUSTRALIAN PROBLEMS

IN Australia, air fares are expected to rise by at least 15 per cent, according to a report in *The Financial Times*. The increase will have been brought about by the increased cost of aviation fuel which came into effect on April 1st. The cost of 100 octane fuel has risen by 10d a gallon to 4s 10½d and 91 octane has risen by 11½d to 3s 11½d.

Including these increased fuel costs, the operating costs of the major Australian airlines will have risen by more than £3,000,000 since the last fare increases in 1950.

An announcement of new fares and freight rates is shortly expected now that the Government has decided on its policy on the future of Trans-Australia Airlines.

T.A.A. was founded by the Socialist Australian Government to operate in competition with Australian National Airways and other private companies. T.A.A. began operations in September 1946 and it has been very successful, but its existence has caused much discontent among the other airlines. Some indication of the feelings in Australia can be obtained from the statement issued by Mr. R. M. Ansett, managing director of Ansett Airways, after discussions which he had recently with the Prime Minister, Mr. R. G. Menzies.

Mr. Ansett said: "I believe that in the first place T.A.A. should have been liquidated immediately the present Government took office. This would have been in accordance with the declared policy of the Liberal Party in Government competition and private enterprise. However, if the Government intends to retain T.A.A., the airlines should be placed on a truly competitive basis by a fair distribution of Government business among all local airlines.

"This should be achieved by setting up an authority or board under the auspices of the Department of Civil Aviation which would allocate Government business and privileges among all local airlines."

Meanwhile the Commonwealth Health Department has handed over control of its aerial medical services in the Northern Territory to Trans-Australia Airlines. This took place on March 1st, when the company took over two D.H. Dragons and a Miles Gemini together with the services of two air ambulance pilots, Capt. Jack Slade, A.F.C., and Capt. Harry Moss.

Air ambulances have operated from Darwin for seven years and from Alice Springs for three years. They have so far flown over a million miles to bush airstrips, taking medical aid to settlers in the outback.

Australian National Airways had threatened that they would go out of business unless they were merged with T.A.A. as a public company; but on March 27th the Government announced that T.A.A. will continue as a separate company and on the following day the Government proposed a rationalization of operations between the two companies to include a substantial share of air-mail to be freely available to both concerns. Scheduling, freight charges, fares and other related matters would be integrated to bring earnings into proper relation with overall costs.

The Government will offer financial assistance to both companies for the acquisition of modern aircraft. The new machines would probably be bought by the Government and chartered to the companies.

If A.N.A. accepts the Government's proposals, an agreement between that company and T.A.A. would probably be executed and ratified by legislation to cover a period of 10 to 15 years.

B.O.A.C. THROUGH GERMANY

ON April 2nd B.O.A.C. was, for the first time in the history of British civil air transport, due to begin services through Germany to India and Japan. This service, which will continue to leave London each Wednesday is one of the thrice weekly London-Tokyo flights operated by the Corporation with Canadair Four *Argonaut* class aircraft and it will call at Frankfurt on both eastbound and westbound flights.

This new *via* Germany service will, after calling at Frankfurt, revert to the old route and continue *via* Rome, Cairo, Basra, Karachi, Calcutta, Rangoon, Bangkok and Hongkong, reaching Tokyo at 19.10 L.T. on Sundays.

CIVIL AVIATION . . .

A GERMAN AIRLINE?

THERE have for some time been persistent rumours that a German airline will soon be formed. A recent report from Bonn suggests that a West German airline will begin operations in the spring of 1953.

The report says that plans for the re-establishment of a German airline are now being prepared in Cologne by former officials of Deutsche Lufthansa. A private company is being formed to operate the airline and Wilhelm Bongers, last director general of D.L.H., has been named as head of the new company.

German Government officials are quoted as saying that the new airline will operate services to North and South America as well as within Western Europe. A fleet of about 30 four-engined and twin-engined aircraft has been forecast and as Germany is forbidden to construct aircraft the airline will have to purchase foreign equipment. No mention of specific types has been made. It is also understood that Germany wishes to become a member of I.C.A.O.

The old Deutsche Lufthansa was founded in 1926 by the amalgamation of Junkers Luftverkehr and Deutsche Aero-Lloyd. D.L.H. operated an extensive network which included a regular South Atlantic mail route; the company was dissolved at the end of the war.

MORE IN MANY

IN keeping with the present trend in increasing passenger accommodation in existing transport aircraft, the U.S. Civil Aeronautics Board has circulated, in a proposed amendment to the Civil Air Regulations, new standards for maximum seating. The figures quoted (which include crew) are: Boeing 307 Stratoliner (61), 377 Stratocruiser (96), Convair-Liner (51), Curtiss C-46 Commando (67), Douglas DC-3 (31), Super DC-3 (35), DC-4 (83), DC-6 and DC-6B (87), Lockheed Constellation L-049 (87), L-649 and L-749 (69), L-1049 Super-Constellation (94), Martin 2-0-2 (53) and Martin 4-0-4 (45). It should be noted that the L-049, L-649 and L-749 Constellations can carry 87 occupants when there are six exits and one door in the passenger section or 69 when there are only four exits and one door in the passenger section.

The figures have been arrived at on the basis of the provision of emergency exits, and evacuation tests under emergency conditions are to be undertaken under C.A.A. supervision. "Passengers" taking part in the tests will be divided into age groups comprising 60 per cent between 27 and 45 and 20 per cent each of 15-26 and 46-65. There will be 20 per cent of women in each group.

In Britain the B.E.A. *Pionair* class DC-3s are carrying up to 32 passengers and three crew and the Corporation's Vikings are being converted to carry up to 38 passengers and four crew.

AIRPORT CHANGES

THE Ministry of Civil Aviation has purchased two airfields under the Civil Aviation Act and a further three are in process of legal conveyance. Those concerned are Islay, Hurn, Land's End (St. Just), Southampton (Eastleigh) and Stansted. Of these, Islay, Land's End and Southampton are used by regular scheduled services of B.E.A.

At Aberdeen, Dyce Airport is to have a new 2,000-yd runway; good progress is now being made and it is hoped that work will be completed by August.

Further south, airport construction has been the subject of discussion by the Newcastle City Council. A plan for the construction of a "utility" runway at Newcastle's airport had been prepared whereby the cost would be only £6,500. It was proposed that 46,000 tons of spoil from a pit heap near Newcastle should be used and 26,000 tons would have been supplied free. Following criticism from Councillor Hutton, who said this runway would be above the level of the surroundings fields, and would be dangerous for heavy aircraft, Alderman Mould-Graham, chairman of the Airport Committee, agreed to take back the scheme for further examination.

A B.I.A.T.A. GATHERING

AT an informal gathering of the British Independent Air Transport Association's members and guests in London last week we learned that a fair number of Associate Agreements have now been approved for 1952 scheduled operations by British independent operators. These include five international route operations, 12 to the Channel Islands, one to the Isle of Wight, seven to the Isle of Man and four cross-country routes.

There are also a number of provisionally approved international and domestic route operations. Two provisionally approved agreements have been withdrawn by the companies concerned.

Not included in the approved list to date is the application of Silver City Airways for a Southampton to Isle of Wight ferry service for the carriage of passengers, cars, motor cycles and pedal cycles. It is hoped that this service will be in operation by Easter. Proposed single fares are £4 6s for a small car, £5 7s 6d for a medium-sized car and £6 9s for a large one. Motor cycles will be carried for 32s 6d, cycles for 13s 6d and passengers for 13s 9d. Return fares will be double the single fare. Bristol Freighters will be used and they will be able to carry two cars, a number of motor cycles and cycles and, in a separate cabin, 12 passengers.

WITH A SHAMROCK ON ITS NOSE: This Bristol 170 Mk. 31 has recently been delivered to Aer Lingus and it will be one of a number of this type to be used by the Irish Air Lines this year.

Scottish Aviation was well represented at the B.I.A.T.A. gathering and we learned that this company has in the project stage a twin-engined development of the Prestwick Pioneer. It is designed for two Alvis Leonides engines and it would carry about 12 people.

The present membership of B.I.A.T.A. is 11, plus six associate and 34 affiliate members.

I.C.A.O. AND THE UPPER AIR

TWELVE member-nations of the International Civil Aviation Organization are engaged in a series of experiments designed to show whether an increase in upper-air weather observations will provide enough benefit to air navigation to justify the additional cost.

The experiments, which are due to end in a week's time, consist of doubling the frequency of most of the upper air observations taken at weather posts in and around the North Atlantic. Over part of the research-period radio and radar wind-observations have been taken every six hours. March and April have been chosen for these experiments as frequent large-scale weather changes occur at this time.

The main purpose of the research is to improve the upper-air weather forecasts upon which the technique of pressure pattern flying depends.

Taking part in the trials are land stations in the Azores, Belgium, Bermuda, Canada, France, Greenland, Iceland, Ireland, Norway, Portugal, Spain, Sweden, the United Kingdom and the U.S.A. The ten Atlantic weather-ships are also participating.

RISING SUN AND AIR

IN November, 1945, General MacArthur, then Supreme Allied Commander, directed the Japanese Government to enforce legislation forbidding the Japanese to engage in aviation. A cabinet ordinance based on this directive has remained intact except for recent amendments permitting certain persons in Japan to take part in commercial aviation enterprises with chartered foreign aircraft.

Under the terms of these amendments, Nippon Koku Kabushiki Kaisha (Japan Air Lines Co., Ltd.) began operating domestic services last October. At present J.A.L. is flying Tokyo-Osaka four times each way on weekdays with one service continuing to Fukuoka; a weekly Sapporo-Misawa-Tokyo service, and a six times weekly Sapporo-Tokyo nonstop service.

J.A.L.'s survey and proving flights were made with a DC-3 chartered from Philippine Air Lines which was painted with Japanese markings—the first aircraft to wear them since 1945.

The present services are being flown with two Martin 2-0-2s and one DC-4, chartered from Northwest Airlines and flown by N.W.A. crews. Japan now hopes that it will soon be free from the Allied ban and the Japanese Government is reported to be seeking Allied approval for a plan under which civil enterprises could buy used U.S. aircraft. The plan calls for the purchase of four light aircraft (at approximately $40,000 each) and two helicopters (at about $32,000 each) for newspaper work and four light aircraft, also at about $40,000 each, for fishing and other duties.

Allied occupation officials in Tokyo are reported to have said that they believe the ban forbidding Japanese to own or fly aircraft will cease automatically when the Japanese Peace Treaty comes into effect.

Leading Japanese newspapers are competing to be first in operating their own aircraft, and they have already selected the types they want and have hired Japanese pilots to fly them.

Before the war, *Asahi Shimbun*, one of the leading Japanese newspapers, used a number of aircraft, and it was one of that company's, the *Kamikaze* (Divine Wind) which flew from Tokyo to Croydon in April, 1937, in 94½hr.

Several commercial firms are making plans to open domestic and international air services as soon as permission is received, and a Japanese railway company has announced that it proposes to start a domestic airline in co-operation with Pan American Airways. This airline would probably be called Japan-American Airways and P.A.A. would supply the aircraft and staff until such time as Japan could supply its own.

MONTREAL'S TRAFFIC INCREASE

THE International Air Transport Association reports that international airline passenger traffic at Montreal has increased 66 per cent in the past three years.

The number of passengers between Montreal and points outside Canada on the scheduled and charter services of the six scheduled airlines which provide international air connections in Montreal has increased from 136,622 in 1949 to 227,651 in 1951.

A total of 533,048 international passengers have entered or left Montreal on the services of Air France, British Overseas Airways Corporation, Colonial Airlines, K.L.M., Northeast Airlines, and Trans-Canada Air Lines during the three-year period. Of these, 432,204 have moved between Montreal and the United States and Caribbean points, and 105,844 between Montreal and Europe.

Passenger traffic from Montreal to points in the United States and the Caribbean has increased by 68 per cent from 107,297 in 1949 to 180,661 in 1951. The number of passengers to or from Europe has increased by 60 per cent from 29,325 to 46,990 from 1949 to 1951.

THE LOCKHEED TRANSPORT YEAR

A BACKLOG of airline orders worth $115,721,000 faced the Lockheed Aircraft Corporation at the end of 1951; this represented 12 per cent of the total year-end backlog.

During 1951 the Corporation delivered 20 standard Constellations and in addition sent out the first four L-1049 Super Constellations. This better type is in full production and Eastern Air Lines' first complete batch of 14 should have been delivered by this time; T.W.A. will receive the next batch, after which E.A.L. will begin to get the first of the Turbo-Cyclone-powered type.

Among Lockheed's projects is the XC-130 turboprop cargo transport.

Lockheed Air Terminal, Inc., at Burbank, reported that during 1951 its earnings were $243,000 on sales of $3,933,000. Passenger traffic at the Lockheed Air Terminal rose 22 per cent, totalling 739,208 arrivals and departures, and air freight increased by 46 per cent to 31,624,607lb.

BREVITIES

THE French airline, Aigle Azur, has recently added seven D.H. Dragon Rapides and three Airspeed Consuls to its fleet for feederline services in the Mediterranean area.

* * *

Sabena is to begin a new service on April 20th between Brussels and the Belgian Congo *via* Rome, Athens and Cairo. A second new Sabena service, to start on April 21st, will operate from Brussels to Barcelona.

* * *

From April 1st, Ringway Airport, Manchester, is maintaining a 24-hour watch, and airline movements will take place throughout most of the period. Scheduled aircraft movements are forecast as 1,300 in June, 1,450 in July, and 1,500 in August (not 84 a week as recently reported).

* * *

On March 2nd, New Zealand National Airways Corporation flew the first of a series of excursion flights from Wellington to Nelson and back (192 miles). Operated with a DC-3, this excursion gave passengers time for a swim at Tahuna beach, and the £5 fare included dinner at the Hotel Nelson and a sightseeing tour of the city.

* * *

Aer Lingus has recently taken delivery of the first of its two Bristol 170s. Registered EI-AFP, this is the 110th aircraft of this type and it was flown from Filton to Dublin by Capt. Hammond and Capt. Martin of Aer Lingus. Mr. Walter Gibb, a Bristol test pilot, flew on the aircraft to Dublin, where he will assist in the training of Irish crews.

One of the thrice-weekly Johannesburg-London Constellation services of South African Airways is to call at Frankfurt-am-Main, probably beginning early this month.

* * *

A Lockheed Lodestar belonging to Société Africaine des Transports Tropicaux (Aero Africaine) met with an accident at Gao in French West Africa last week; the crew of three and 13 of the 16 passengers lost their lives.

* * *

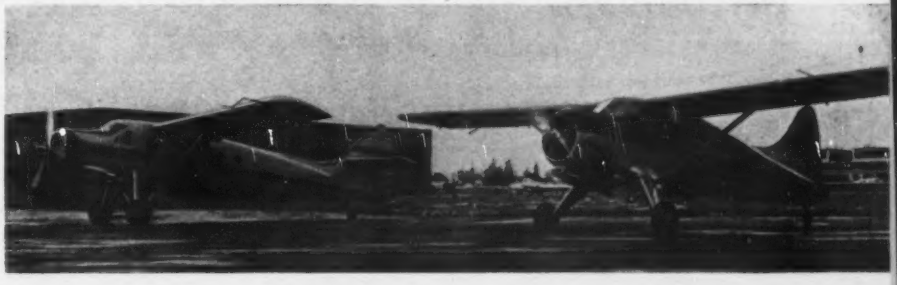
In order to attract traffic to the sterling area, B.E.A. is this month reducing its fares from London to Cyprus and Malta. Twenty-three-day return fares will be £115 to Cyprus and £60 to Malta. These represent savings of £20 and £12 respectively. The Cyprus route is operated in association with Cyprus Airways.

* * *

W. S. Shackleton, Ltd., of London, has recently supplied an Airspeed Consul to Líneas Aéreas Españolas—Iberia, the Spanish national airline. The Consul bore the British registration G-AHRK and will now become EC-WGI. Shackletons had already sold two aircraft—Dakotas G-AJAY and G-AKLL—to Iberia in June, 1950.

* * *

A "new" lake, several miles long, and shaped like a boomerang, has been discovered 2,000ft up in the Cameron Mountains, near Long Sound, in Fiordland, New Zealand, on a survey flight by officials of Southland Amphibian Airways. The company, which has plotted the location of other lakes, is seeking permission to use them for amphibian operations. The country was found to be teeming with game, and ideal for hunting.



THE OTTER AND THE BEAVER . . . Seen here at Toronto are the Canadian de Havilland Company's DHC 3 Otter (left) and the DHC 2 Beaver. The Otter was designed to meet the requirements of operators needing a larger aircraft than the Beaver, and while it was in the design stage this new type was known as the King Beaver.

CIVIL AVIATION . . .

FROM THE CLUBS

IN conformity with the Southern Aero Club's intention to organize such events at frequent intervals, a tea patrol is to be held at Shoreham Airport on April 20th. The defending aircraft will be patrolling between 3.30 and 4 p.m. and "invaders" must fly at an altitude of between 1,000 and 2,000ft. Participants are asked to observe the usual S.A.C. rule for such affairs, namely, to avoid approaching from the seaward side of the railway line on the southern boundary. The three pilots landing nearest to a sealed time between 3.30 and 4 p.m. will each receive a prize, and after tea there will be a height-judging competition.

If some other club can organize a luncheon patrol for April 20th the more skilful pilots will be well victualled for the day, as Redhill are staging a breakfast patrol in the morning!

SINCE the beginning of the year the Cheltenham Aero Club, which operates from Staverton Airport, has logged nearly 200 hours. Operating a fleet of Autocrats equipped with radio, and hoping shortly to obtain permission to re-introduce night flying, the C.A.C. offers useful training for would-be commercial pilots; three members are at the moment studying for their Commercial Pilots' Licences. At present the club has 93 flying members, 15 of whom are training for their P.P.L.s.

A new restaurant, a Link Trainer room, photographic quarters and a radio room are being established in two brick buildings made available by the Corporations of Gloucester and Cheltenham, owners of Staverton. Incidentally, when Staverton was de-requisitioned and the C.A.C. was consequently forced to suspend night flying because it had no suitable beacon, club members decided to make their own 5 kW beacon; it now only awaits erection. An angle-of-approach indicator—another requirement for the club's night-flying—has also been made by a member.

THE proposal put forward by the Aero Club of South Africa that a national air fund should be established from a tax on petrol—on the lines of the national road fund—has been rejected by the Government. Col. A. M. Broad, chairman of the club, expressed his disappointment at this decision and added that such a fund would have yielded about £20,000 a year—"little enough to the Treasury, but of immense value to civil aviation."

AFTER seven years of negotiations with the Ministries concerned, the Scottish Flying Club has at last been granted permission to resume flying from its original base at Renfrew. It will be remembered that after the war the club's request to re-occupy the airport was refused and, instead, they moved across to Scone Airport, Perth, where they have operated until now.

The S.F.C. hopes to begin operations within the next few weeks and a fleet of Miles Magisters is to be purchased. In addition, new buildings and hangars will be built if suitable accommodation is not made available.

Mr. John McKean, president of the club, said recently that no flying training had been undertaken in the West of Scotland for many years and that he hoped the S.F.C. would shortly begin filling the national need for young, trained pilots.

TWO changes in flying-school ownership have recently taken place in the south of England. Firstly, the Elstree Flying School—until a few weeks ago operated by Mr. D. G. S. Cotter—has now been acquired by Mr. R. R. Paine, the well-known racing pilot, and thus becomes the third flying school of which he is a director (the other two are at Wolverhampton and Derby). Though, when we paid a recent visit to Elstree, the new organization had been in residence for only a fortnight, good progress was apparent. Instruction and club flying was well under way, and some changes were noticeable, among them a long-overdue coat of paint on the flying-control hut.

Secondly, Mr. Cotter has moved his school down to Garwick, where he has begun operations with a small fleet of Austers. Having taken over a part of the flying-control building, and with access to the amenities provided in the handsomely equipped terminal building, Mr. Cotter's little band—to be officially known as "The Penguin Squadron"—already appears to be happily settled in.

AGRICULTURAL AUSTER: Seen at Elstree recently, before taking delivery of this Auster V, is Mr. V. G. E. Hourcush, who is shortly to fly the machine back to his home in Istanbul. With two other Austers—also acquired from Elstree, by two of his colleagues—Mr. Hourcush plans to carry out extensive crop-spraying activities in Turkey. The three Austers will replace Magisters now performing similar duties there.

FRENCH SAILPLANE: The latest of the Fouga CM 7 series, which will probably be entered for the International Gliding Championships, to be held in Spain this summer. It has a 59ft wing-span and weighs 858 lb.

THE Aéro-Club du Touquet has announced that a trophy is to be given annually by the Bar-Restaurant, Le Touquet Aerodrome, together with prize-money of 80,000 fr. offered by the Casino de la Forêt. Points are to be awarded for each landing made by a visiting pilot at Le Touquet Aerodrome after a flight of at least 150 km (93 miles), and the pilot gaining the highest aggregate will win the trophy and cash prize. The competition—which we forecast last year—is open from April 10th to September 21st.

Details can be obtained from the Royal Aero Club Air Touring Department at Londonderry House.

THE 1952-53 edition of the *Air Touring Guide to Europe* is now on sale at the Royal Aero Club, price 7s 6d (by post 8s). All information contained in earlier editions has been brought up to date and there is an increase of 20 pages over last year's volume. Additional information includes a chapter on air rallies, and details of meteorological facilities in the United Kingdom

FORTHCOMING EVENTS

Apr. 4. College of Aeronautics: Senior Common Room Society's Annual Dinner.
Apr. 6. London Aeroplane Club: Dawn Patrol and A.G.M.
Apr. 15. R.Ae.C.: Film Show
Apr. 16. Aircraft Recognition Society: Annual General Meeting.
Apr. 21-24. S.A.E. Aeronautic Meeting, New York.
Apr. 22. R.Ae.S. Graduates' and Students' Section: "Servomechanisms," by F. H. Borlace, B.Sc.(Eng.), Grad.R.Ae.S.
Apr. 22-24. R.A.F. Golfing Society: Spring Meeting, Walton Heath.
Apr. 24. R.Ae.S.: "Fuel Systems for Turbine-driven Aircraft," by J. E. Walker, A.F.R.Ae.S. (at Luton).
May 3. Vintage Aeroplane Club: Rally, White Waltham.
May 3-10. F.A.I.: Committee Meetings, Madrid.
May 5. I.A.T.A.: Fifth Annual Technical Conference, Copenhagen.
May 5-16. British Industries Fair.
May 10. Exeter Aero Club: Display.
May 10-11. l'Association des Amis de l'Aumonerie de l'Air: Rally.
May 17. Wolverhampton Aero Club: Display.
May 22. Aero-Club du Dauphine: Air Meeting, Grenoble.
May 22. Aero-Club de France: Coupé Stemm (helicopters).
May 24-25. Ragosine-Auster Trophy Navigation Competition, Rearsby.
May 29. R.Ae.S.: Fortieth Wilbur Wright Memorial Lecture: "Prophecy and Achievement in Aeronautics," by Sir Harry M. Garner, C.B., M.A., F.R.Ae.S.

With 20 years' leadership in the design and manufacture of civil and military transport and training aircraft, PERCIVAL'S more recent developments—the PRINCE and the PROVOST— have achieved outstanding success in commercial and service aviation.

The PROVOST, side-by-side two-seat Basic Trainer, fitted with the Alvis Leonides engine, is fully equipped for modern all-weather flying, and its performance and handling qualities are perfect for a trainer. Winner of competitive Service trials, the PROVOST is in large-scale production for the ROYAL AIR FORCE.

The PRINCE, powered again by 'Leonides' engines and in world-wide use as a civil transport, has also been adopted by the ROYAL NAVY and the ROYAL AIR FORCE. In Naval Aviation the SEA PRINCE is employed for communications and as a 'flying classroom' for radar, radio and navigational training. The initial duties of the PEMBROKE—R.A.F. version of the PRINCE—include passenger transport, freighting, long-range ferrying, supply dropping and casualty evacuation.

For civil operation the PRINCE serves for executive travel and with internal airlines carrying 8 to 12 passengers: its exceptional capacity, comfort and high performance meet the exacting demands of world-wide operating conditions, whilst versatility is exemplified by the SURVEY PRINCE, the only modern British aircraft developed especially for aerial photography, mapping and land survey.

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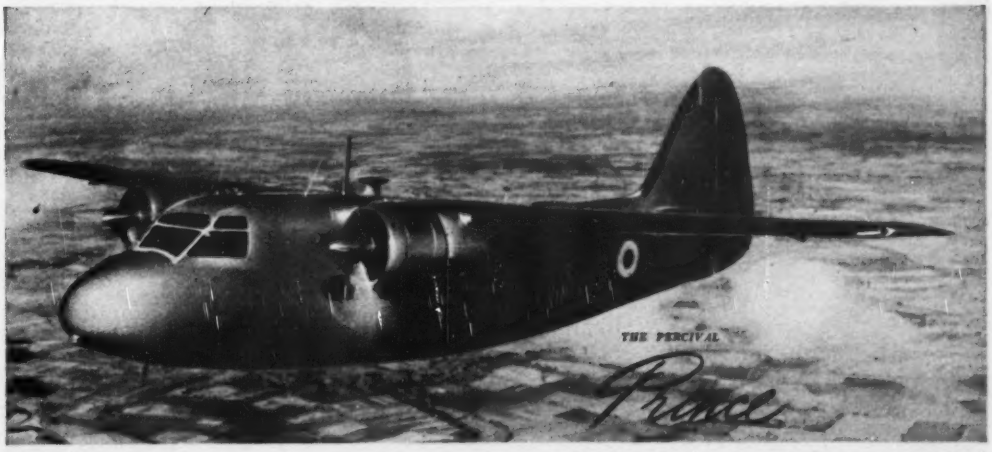

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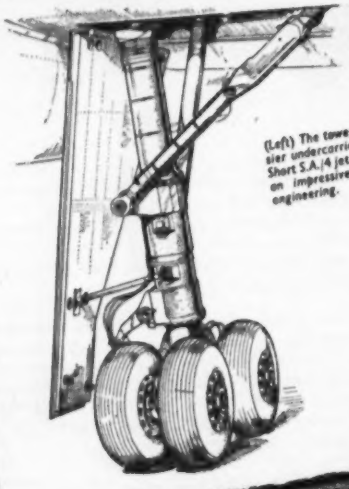
MESSIER *Landing Gear*

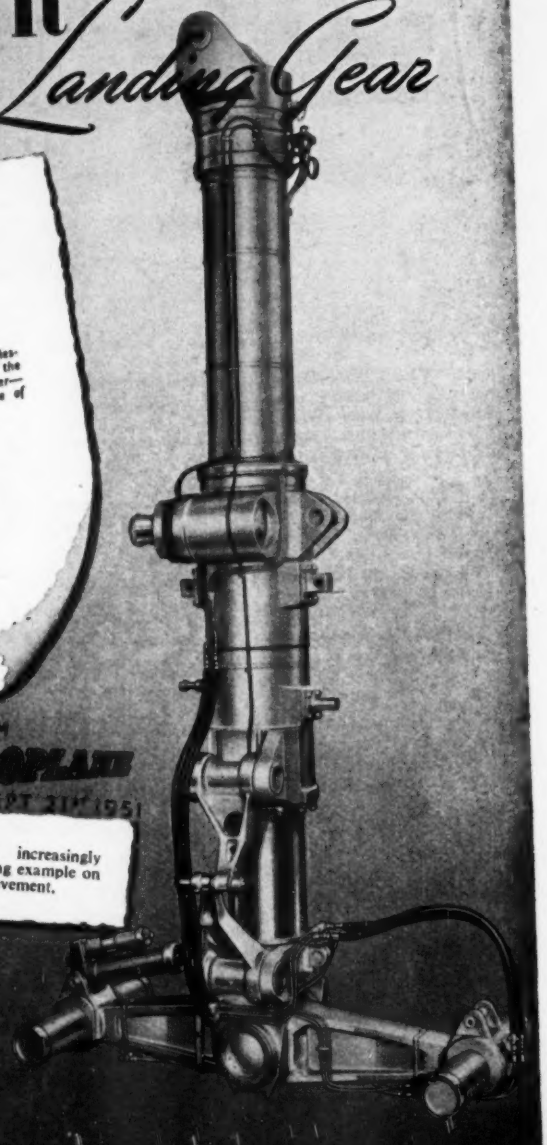
FROM FLIGHT AIRCRAFT ENGINEER SEPT. 21ST 1951



(Left) The towering Messier undercarriage of the Short S.A.4 jet bomber—an impressive piece of engineering.

FROM THE AEROPLANE SEPT 21ST 1951

Bogie-wheel undercarriages are becoming increasingly common at Farnborough, and the inward-retracting example on the Short SA.4 is a magnificent engineering achievement.



Twenty-three years experience in the design of hydraulic landing gear for aircraft is incorporated in every Messier undercarriage design.

BRITISH MESSIER LTD · GLOUCESTER

AT CONFERENCE UNICORN: Last week the Chief of the Air Staff held a five-day conference at Old Sarum under the code name of "Unicorn." It was attended by many senior officers from British and foreign Services. On the left, Marshal of the Royal Air Force Sir John Slessor is seen with Major Gen. V. D. Thomas, R.M., and Air Chief Marshal Sir Ralph Cochrane. On the right, Air Chief Marshal Sir Hugh Pughe Lloyd and Air Marshal Sir Basil Embry appear in a cheerful mood—perhaps they had already heard of "super-priority."

SERVICE AVIATION

Royal Air Force and Naval Aviation News

R.A.F. Appointment

FROM April 1st, Air Marshal Sir Ronald Ivelaw-Chapman, K.B.E., C.B., D.F.C., A.F.C., became A.O.C.-in-C. Home Command. Until recently Sir Ronald was C.A.S. and C.-in-C. of the Royal Indian Air Force, a post which he held on leaving a staff appointment at the Imperial Defence College.

The Air Ministry has also announced that A. V-M. F. J. Fressanges, C.B., is to be Assistant C.A.S. (Intelligence).

"Glory" has Record Day

DURING a recent patrol off the west coast of Korea the carrier H.M.S. *Glory* was asked to make an extra effort in addition to normal patrol duties.

Despite bad flying conditions, the 14th Carrier Group, commanded by Lt. Cdr. F. A. Swanton, D.S.C., R.N., stepped up the total number of sorties and in one day alone flew no fewer than 105, each of normal duration. This is a record for this class of ship and brought congratulatory messages from both U.S. and British commanders, including one from the Fifth Sea Lord, Vice-Admiral E. W. Anstice, C.B.

H.M.S. *Glory* (Capt. K. S. Colquhoun, D.S.O., R.N.), has now completed more than 4,000 operational sorties since sailing to Korea last April. She is now due to be relieved by H.M.S. *Ocean* (Capt. C. L. G. Evans, D.S.O., D.S.C., R.N.) and will rejoin the Mediterranean Fleet.

Queen's Prize for Bisley

THE National Rifle Association has been informed that Her Majesty the Queen intends to follow the precedent of earlier Sovereigns and give a prize of £250 annually for competition among marksmen of Britain and the Commonwealth.

The Queen's Prize winner for this year will be decided in July at the Imperial rifle meeting at Bisley.

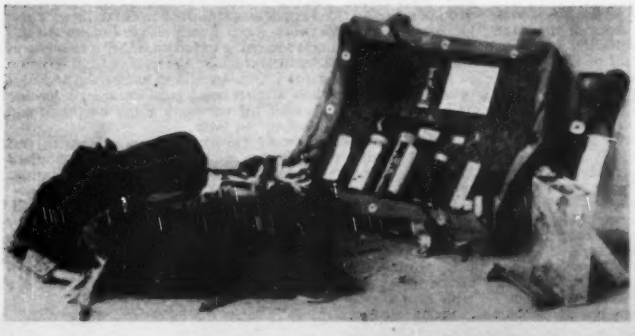
Jungle Party Return

THE seven members of the R.A.F. party that recently trekked through the jungle swamps of North Borneo, living entirely on the contents of a new jungle survival pack, all returned safely.

S/L. T. Brennan, the M.O. and joint leader of the party, said that a lot had been learned from the trek. Among other things, it had shown the vital importance of salt to men on the march, as a means of avoiding heat exhaustion. It had also demonstrated that men could live for long periods on properly prepared concentrated foods, with an improvement rather than a deterioration in their physical condition.

The results of the trek will be studied with view to evolving a survival pack for issue to fighter pilots operating in Malaya.

SURVIVAL PACK: The cushion-type survival pack recently tested in North Borneo (see "Jungle Party Return"). It includes gloves, socks, jungle hat, mosquito net, water bottle and water-purifying tablets, compass, sewing kit, cooker, first aid, flares, insect repellent, concentrated food rations, fishing equipment and a miniature jungle-machete.



C.O. Lends a Hand

WHEN F/L. Grant of No. 613 (City of Manchester) Squadron R.Aux.A.F. was in trouble with the hydraulic system of his Vampire recently, S/L. J. B. Wales, flying a Lancaster, was able to go alongside and examine the Vampire's undercarriage. Four attempts were made before the undercarriage locked safely down and a landing made. S/L. Wales is the commanding officer of No. 613 Squadron and is also one of Avro's test pilots. On this occasion he was testing one of the Avro Lancasters which are being reconditioned for the French air force.

A.T.C. and Cadet Officers' Rank

A RECENT Air Ministry order states that in future officers of the Training Branch of the R.A.F.V.R. will on resignation be permitted to retain Air Force rank equivalent to the highest acting rank held for not less than six months as a Cadet Force officer. Similar permission may also be granted to officers who have retired since April 1, 1949, on written application to the Air Ministry.

This permission is granted only at the discretion of the Air Council and a necessary qualification is ten years' satisfactory service. Commissioned service in the Regular, Reserve or Auxiliary Forces, including the Home Guard—or in the Cadet forces of the other two Services—may be included.

The grant of rank does not carry the right to wear uniform, except on authorised occasions.

Maintenance Command Tie

A TIE has been designed for wear by past and present officers, and civilians of officer status, of Maintenance Command. It costs 19s post free and is obtainable only from the P.A. to the A.O.C.-in-C. Maintenance Command, R.A.F. Airport, Andover, Hants. Requests must be accompanied by a remittance and details of service in the Command.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Film Fiction and Fact

WHY is it that film producers, when making films with an aeronautical flavour, have to spoil the ship for the proverbial ha'p'orth of tar?

Readers of *Flight* will know of the efforts put in by the producers of *Angels One Five* to convert the Hurricane IICs, on loan from Portugal, to the Mk 1s used in the Battle of Britain. Consequently, one expected such authenticity to prevail throughout.

But, when the film is made and released, what do we see? The Hurricanes are authentic enough, except for the periodic changing of markings from 1940 to 1942 standard—and back again—which miraculously occurs during a single sortie, and Harvard 2s are shown taxying merrily around in silver dope—in 1940, mark you. Many, no doubt, would not observe these comparatively minor points, but very few of us could remain unshaken at the appearance of models of a crossbreed design (Junkers 88 and Henschel 129, apparently) which represent the *Luftwaffe* and which stagger around the screen like a seaside Punch and Judy show.

London, S.W.20. DISAPPOINTED.

ONE hears that Associated British Picture Corporation are soon to make a film of *The Dam Busters*, in which Richard Todd is to portray the late W/C. Guy Gibson. May I express the hope that, even if the producer has all the experts he wants to vet the script, he does get someone who knows what squadron life was really like to see the shots before he makes them into the final film?

The thought is prompted by assurances that *Angels One Five*, which attempts to depict life on a typical war-time fighter station, had the usual quota of experts in attendance and the blessing of Air Ministry. Now I was never in Fighter Command, but if the characters and general set-up of the squadron in this film give a faithful reproduction, then one can only express the opinion that the Battle of Britain was a bigger miracle than it has been acclaimed.

There may be little doubt that *Angels One Five* will give good entertainment to the general public. But it was also intended as a tribute to the Royal Air Force, and Fighter Command in particular. Why, then, must its central character be a pilot who seems to go out of his way to provide a walking definition of the word "clot"?

His arrival at the aerodrome in a replacement Hurricane is not without drama. He obtains permission to land and proceeds to do so in a very correct manner. For some very unconvincing reasons it so happens that one of the squadron Hurricanes is made to land across wind in front of him. By a superhuman spot of flying the new boy leap-frogs over the cross-wind type but crashes out of control at the end of the runway and finishes up, very conveniently, a few feet from the front door of the house occupied by the Operations Controller. The new pilot is blamed for the crash and for jeopardizing the life of the pilot landing across the runway! The programme synopsis tells us that he nurses a sense of grievance over this. One can hardly blame him.

But he can be blamed (or the writers of the story can) for his future behaviour in the squadron, although here again he was not encouraged by the attitude towards him of his superior officers—an attitude which, if it had been typical, would very quickly have destroyed the magnificent spirit and *esprit de corps* of which Fighter Command was justly proud.

Much of the action of the film takes place in the ops. room, and these scenes are very realistic. The wrecking of the room in the first German raid on the aerodrome is especially well done. The controller is warned of the impending attack by the look-out on the roof. As this look-out is not of commissioned rank he must follow film, stage, and literary tradition by speaking with a pronounced Cockney accent. He tells the controller that so many Heinkels are approaching the aerodrome at ten thousand feet, and we then see the enemy aircraft hopping over the hedge and dropping their bombs with abandon from nought feet.

Meanwhile the new boy has rushed out, grabbed himself a Hurricane, and shot down a German bomber right into the field adjoining the aerodrome. Good show? Not a bit of it! He gets a strip torn off him because he left his R/T transmission switch on, and so other pilots in the air could not receive or transmit messages! He must have been a very heavy breather.

I, and others who agree with me about this film, have been accused of being hyper-critical. "These are mostly just technical faults" we are told. But why excuse them on that account? With the expert advice which was available why not have things correct? It is just as easy as being wrong. For example: (1) When a pilot is told by Control to watch for "Bandits" crossing in front from starboard, why does he immediately scan the sky to port? (2) When a squadron scrambled in those hectic days in 1940, the aircraft did not take off in formation. (3) Flight lieutenants do not (or, at least, they *did* not) punctuate every sentence with a reverential "Sir" when speaking to a squadron leader. (4) How did the station commander get all those gongs? O.B.E., M.C., D.F.C., A.F.C., and others not identified. Good going for a young man in 1940! (5) "Angels one five" does not mean fifteen thousand feet—unless Control were being very subtle. (6) No pilot ever shot down an enemy by diving on him and firing from full astern; nor did he obtain a kill by opening fire on a beam attack when the enemy was in the centre of his sight.

I could have excused all this if the producers had not made the young pilot stand by the side of his girl friend and, with eyes gazing into the far distance, proclaim that he wanted nothing more than to be alone with his aeroplane in the great blue sky. Anyone who said that—and I doubt that any R.A.F. type has ever said it—deserved to get the chop. Which, indeed, this chap does, in a very melodramatic finish in which his voice fades out from the loud-speakers in the control room.

London, W.1. ALEX THORNE.

Air-to-Air Photographers

I WAS very surprised and disappointed to read your remarks on "the three past-master aeronautical photographers" in your report, "Aerial Art on Show," on page 329 of *Flight* for March 21st.

Knowing well all three of the excellent photographers in question, I feel sure they would regret as much as myself that the list of "past-masters" was not extended to include Cyril Peckham. The mere fact that he won first prize in the black-and-white photograph section of the Intava aerial photography competition in New York a few years ago, under the noses of American photographers who have all-the-year-round blue skies to practise in, surely justifies his place among the masters.

London, W.1. JOHN W. R. TAYLOR.

[We are sure there was no intention to overlook the excellent work of Cyril Peckham; when Charles Brown mentioned Charles Sims and John Yoxall he was referring to staff photographers of aeronautical journals and to those who, like himself, were veterans at the game.—ED.]

Bread-and-Butter Airliners

WITH reference to Mr. Basil Clarke's letter (March 21st), I would venture to suggest that your correspondent, in commenting on "our wishful thinkers" is indulging in a spot of "wishful thinking" himself when he states the DC-3 and, to a much lesser degree, the Lodestar, "will go out of service within a short time of each other."

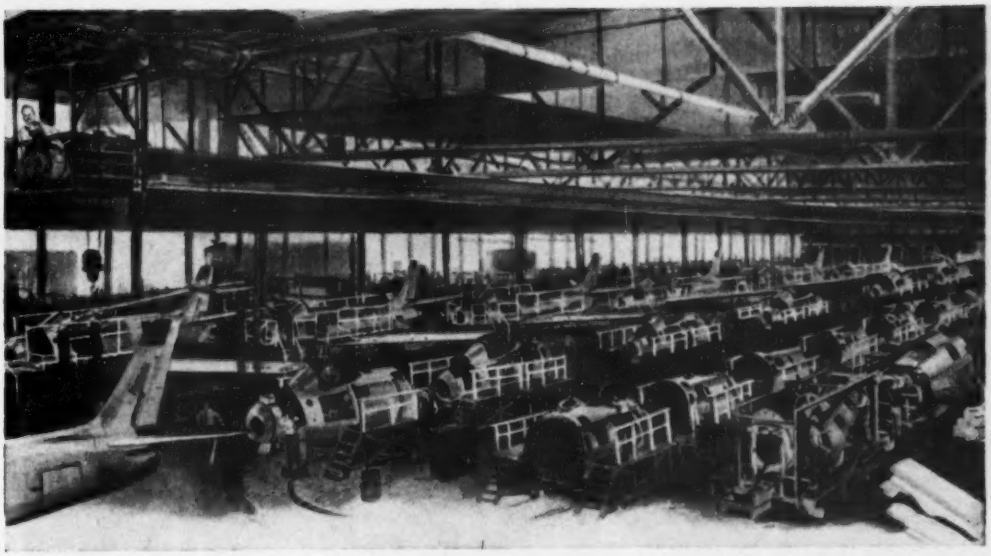
He seems to have completely ignored the fact that B.E.A., Capital Airlines, United Airlines, and T.W.A.—to quote just four famous airlines—have considered it worth the expenditure of considerable capital (in B.E.A.'s case, some £500,000 for the conversion of 38 DC-3s to Pionair Super DC-3 standards), because he too, has fallen for the much publicized "obsolescence" of the "old" Douglas money-maker!

Converted to carry up to 32 passengers, and with other necessary "refinements," the DC-3 is going to be good for another five years of money-making operations at least. Moreover, there is now ample evidence that very large numbers of Commonwealth operators using this type are going to follow B.E.A.'s example in this respect. A recent statement by the Director of Civil Aviation in India, where about 100 DC-3s are still in use by the principal operators, speaks of these aircraft being good for at least another 10,000 hours per unit, after the necessary major overhauls and other "mods" are carried out on them.

Does Mr. Clarke seriously believe that Commonwealth and foreign operators using DC-3s are going to be able to afford large sums of money in capital investment, purchasing un-proven types?

Finally, in regard to Mr. Clarke's acid comment on B.A.A.C. purchasing Italian Macchi B.320s, I cannot honestly believe they have been forced to do this because "they have no dollars to spare." Judging from the vast numbers of luxurious American cars, plus a goodly number of modern U.S. private-owner type aircraft I saw when I last visited British East Africa, I find it a trifle hard to swallow his statement!

Prestwick, Ayrshire. DENNIS M. POWELL.



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For further information: European Representative, J. H. Davis, Princes House, 190 Piccadilly, London, W1, England.

Vignettes of
CANADA — AIR LAND
Canada has for years taken a lead in map-making by aerial photography and last year completed an entire air map of the country after 25 years of work. Recently new advances have been made by the Canadian Geodetic Survey in conjunction with the Royal Canadian Air Force. New techniques are now in use that permit precise measurement of distances of up to 300 miles and accurate pictures are taken at levels up to 35,000 feet. Also by the use of oblique and vertical photographs highly accurate maps on scales of 8 miles to the inch are now possible.
These advances are helping to speed the search for new natural resources and are typical of Canada's use of the air in her national affairs.

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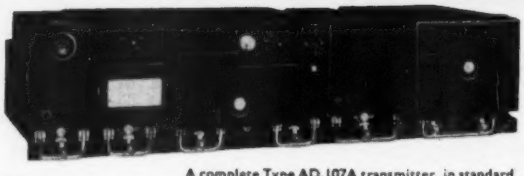
CABZ-TURT



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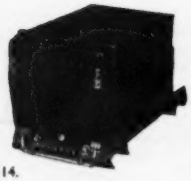

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BOGIE UNDERCARRIAGES

A Necessity for Heavy Aircraft: Current Practice Reviewed in R.Ae.S. Lecture

IN a Section Lecture to the Royal Aeronautical Society on March 4th, R. C. Cussons, D.F.C., M.A., A.F.R.Ae.S., assistant chief designer of Dowty Equipment, Ltd., gave one of the first public assessments to be made of the bogie undercarriage. He confined his paper to a discussion of the use of bogies in general, together with an appraisal of a number of patterns currently in use. A digest of his remarks follows.

One of the chief advantages of the bogie undercarriage, said Mr. Cussons, was that it enabled a given aircraft to impose a much reduced maximum bending moment upon a concrete slab runway. With aircraft weights progressively increasing, the only alternative to the use of bogies appeared to be to increase the concrete thickness—a much more costly undertaking.

The lecturer gave examples of aircraft which, originally designed with single main wheels, had later appeared with bogies, adding that even the 85,000 lb Lincoln was on the verge of exceeding the permissible runway loading and, if designed from scratch today, would have at least two main wheels per undercarriage, if not four.

The runway loading index, in fact, forced the designer to adopt the bogie undercarriage for any aircraft of over about forty tons gross weight. With the adoption of such an undercarriage secondary advantages usually accrued; in particular, though the gear itself would weigh more, an overall weight-saving was effected by the lower aggregate weight of wheel, tyre and brake assemblies. The prototype Comet's single-wheel main undercarriages weighed together, 3,815 lb; those of the production aircraft, complete with the eight wheels and brakes, weighed only 3,598 lb.

Further advantages were, in certain installations, the possibility of easier stowage of a fore aft retracting bogie (with small-diameter tyres) by rotating the bogie during retraction so as to keep the wheel axles in a near-horizontal plane, and the benefit of "safety in numbers" where burst tyres were concerned.

Turning to the debit side of the picture, Mr. Cussons cited the difficulty of ground manœuvre as the bogie's greatest drawback. If a bogie were turned about its vertical centre, the direction of movement of the tyres was almost parallel to the wheel axles, so that they scrubbed sideways with practically no rotation (Fig. 1). Handling notes for bogie-equipped aircraft generally recommended a minimum turning radius, together with the corresponding nose-wheel steering angle.

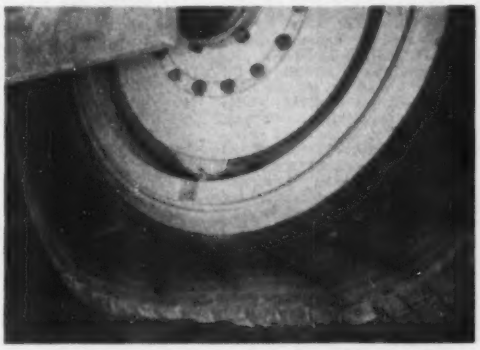


Fig. 1. Careless taxying can cause damage to bogie tyres; this shows the effect of turning a Brabazon 2 unit at 12ft radius in a test rig.

Another disadvantage was the difficulty of performing drop-tests; with a single wheel, drag and side loads could be simulated by wedges, but space limitations often prevented this with bogies. The drag case could only be obtained by dropping the bogie with backward-spinning wheels, giving the same effect as occurred at touch-down.

In the bogie an increase in complication had to be accepted while there had been rumours—from America—of a tendency to pitch, or porpoise, while taxying. This trouble had not, however, been a bother in this country.

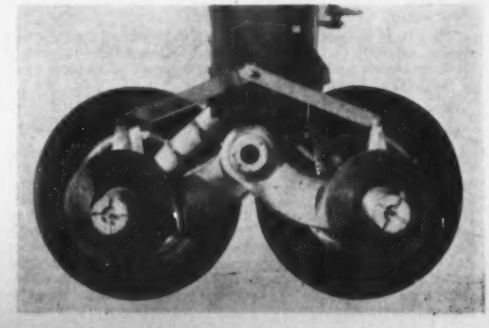
Dealing first with the "beam-engine" type of bogie, Mr. Cussons said that a good example was the undercarriage fitted to the Convair B-36. This was really a double-levered-suspension unit, with the levers pointing both fore and aft. The main shock-absorber connected the middle of the front lever to the front end of an upper pivoted beam which then transmitted the deflection to the middle of the rear lever. This had the effect of translating the upward movement of the rear wheels (which struck the ground first) into a downward movement of the front wheels, without compressing the shock absorber. Thus the front wheels hit the ground at about twice the aircraft descent-rate.

In the de Havilland Comet, a very similar principle was employed, although in this undercarriage (Fig. 2) brakeloads were transmitted by links to the main leg instead of to the bogie. These links were so arranged as to give no tipping moment to the bogie at the static position; at other positions of the wheel levers there was a slight out-of-balance, either backwards or forwards, depending upon whether the wheel axles were above or below the normal static position.

The next unit dealt with by the lecturer [that for the Short

Fig. 2 (left). The first Comet bogie (port unit with the inner wheels removed) with fittings machined from solid. The production bogies, with parts made from drop-stampings, look even neater.

Fig. 3 (right). Brabazon 2 bogie on the drop-test rig; again, the inner wheels (four of them) have been removed to reveal the bogie construction.



BOGIE UNDERCARRIAGES...

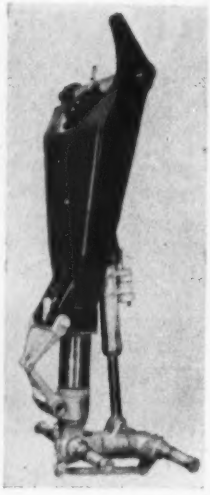


Fig. 4. An example of the scooter-type bogie. This eight-wheel unit employs only one shock-absorber, attached to the centre of the beam.

S.A. 4.—Ed.] was an orthodox shock-absorber leg with a continuous beam pivoted at the lower end to take the two axles. The sideways retraction of this unit did not permit full advantage to be taken of the small diameter wheels, but kept the wheels close together and tended to reduce the effective "footprint" rectangle. The anti-pitch shock absorber was, in this case, mounted at the rear; this allowed the front wheels to touch first in a tail-up landing, when the spin-up drag of the rear wheels tended to counteract the pitching moment somewhat and so reduce the impact on the front wheels.

The Brabazon 2 undercarriage (Fig. 3), like that of the Comet, had separate levers fore and aft, but was fitted with two main shock-absorbers together attached to the upper end of a vertical lever pivoted at its lower end to the same shaft as the wheel levers. The bogie was thus a complete unit free to rotate about the main pivot shaft. Pitching was damped by jacks connecting the main structure to an arm extending forward from the shock-absorber lever; these jacks also turned the bogie (clockwise and then anti-clockwise) during retraction so that it could "climb over" the front spar. This was achieved by so operating a four-way valve from a cam that, as the gear retracted, the valve and follow-up linkage admitted oil first to the upper end of the jack and then the lower. During a tail-down landing the entire bogie could rotate about the main pivot and, in so doing, pull out the trimming jacks to force oil through relief valves and restrictors, thus damping any tendency to porpoise. Brake torque was taken off to the main structure as on the Comet; if it were passed to the wheel levers, the front tyres would be overloaded by 21 per cent.

The lecturer then described a pattern of undercarriage (Fig. 4) which, early in life, had earned itself the nickname of "scooter", although the resemblance had since diminished. The bogie was attached to the lower end of a large sliding tube by the front axle, while the shock-absorber was attached to the centre of the bogie beam. The main sliding tube housed no shock-absorber but was free to slide into the main attachment-fitting without resistance; emergence beyond a certain point was prevented by stops. On landing, the rear wheels struck the ground first; this rotated the bogie about the front axle and partially compressed the main shock-absorber. Thus, not only was the usual overloading of the front wheels eliminated by hingeing the bogie at the front axle, but the position of the shock-absorber enabled it to do the work usually requiring two, or more, main and auxiliary absorbers. During retraction forwards the bogie was turned to lie flat. Each of these "scooter" bogies carried eight wheels, thus still further spreading the load and facilitating stowage in a thin wing.

A variation of this type of bogie (Fig. 5) used the main shock-absorber to meet drag loads. Downward movement of the front axle was prevented by the telescopic strut at the front, which could collapse but not extend. This pattern did not lend itself quite so readily to "flat" retraction, but this did not affect the example illustrated, which retracted sideways.

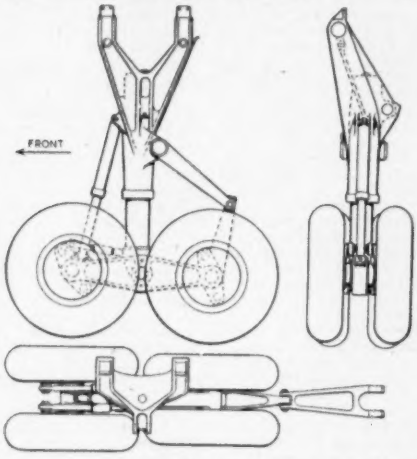


Fig. 5. This "modified-scooter" bogie uses the main leg to absorb drag loads; the brake-torque linkage is very prominent.

CIRRUS MAJOR AUTOCAR

PRIVATE pilots who are in the enviable position of being able to afford their own aircraft will be interested to learn of the latest addition to the Auster family—the 155 h.p. Cirrus Major Autocar J/5G. In general layout it follows the lines of the well-known Gipsy-engined four-seater, but the extra 25 h.p. of the Cirrus Major promises enhanced performance.

The J/5G has an improved rate of climb and shorter take-off run. At full load (2,450lb) into a 5 m.p.h. wind the unstick run is 110 yd and the initial rate of climb 860ft/min. The comparable figures for the 130 h.p. Gipsy-powered four-seaters are 180 yd and 620ft/min.

The first of the new J/5Gs was recently shipped to Australia, and Auster Aircraft, Ltd., hope to have a considerable number of these machines ready for delivery by August. The basic price of the J/5G is £2,125.

HEADS I WIN

AMERICAN inter-service rivalry once again seems to be getting a little out of hand. The Joint Chiefs of Staff Committee has been unable to agree upon any system of priorities for the requirements of each service. Trying to resolve the *impasse*, the Army, Navy and Air Force were each asked to name four items for "top priority." The U.S.A.F. picked four projects: two for aircraft, one for an engine and one for an electronic development; the Navy chose minesweepers, aircraft and engines, while the Army plumped for ammunition. These were all long-term projects. Then a further system of priorities was asked for between each Service; the final upshot was the tossing of a coin—and the Air Force won.

HISTORY REPEATS ITSELF

THE U.S. Department of the Air Force recently confirmed a report by Dr. J. P. Henry concerning very-high-altitude rocket ascents made by live animals. The doctor, who is attached to the aero-medical laboratory of Wright-Patterson A.F.B., Dayton, Ohio, gave details of a number of experiments conducted at White Sands proving ground, New Mexico, in which monkeys and mice had been carried in V-2s up to altitudes of about 80 miles, and in Aerobee rockets up to 40 miles.

On one ascent five monkeys were used; they were first rendered unconscious by morphine injections and were then placed in cylindrical capsules laid sideways across the rocket front bulkhead. Eight hours' recirculating oxygen supply was provided, but an apparatus was carried to record the monkey's pulse and breathing rate. Unfortunately, the parachutes attached to four of the capsules failed to open when the capsules were released, while the fifth monkey landed safely, only to die of heat prostration in the desert.

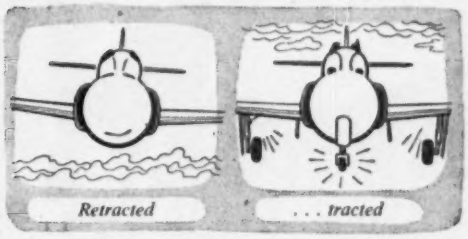
Not all the animals suffered ill effects and numerous mice are reported to have romped about "quite normally" after cameras had shown them to have been in free fall for several minutes in a "weightless condition."

The classic argument that a million monkeys using a million typewriters for a million years would eventually type out the whole of the *Encyclopaedia Britannica*, suggests the possibility that future rocket-passengers of this species might be trained to produce their own flight-test reports. More seriously, of course, the experiment recalls the younger Montgolfier's 1783 demonstration when a sheep, a cock and a duck were sent aloft in the wicker car of a hot-air balloon: only a few months later the first human passengers, Pilâtre de Rozier and the Marquis d'Arlandes, made the first ascent in a free balloon.

Essolutely!

BY BERNARD HOLLOWOOD

WE'RE all agreed, I take it, that one of the most endearing features of any aircraft is its retractable undercarriage. We are also agreed, I hope, that this retractable undercarriage should not only retract when



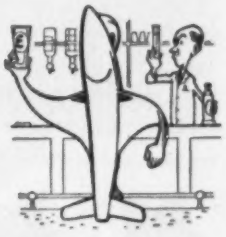
necessary but should *tract* and be tractable at all times. We are? Good. Well, this goes, too, for other airframe accessories—wing flaps, control tabs and so on.

Now these gadgets, if the term is permissible, are usually operated hydraulically—you know, according to the principles of hydraulics, hydrodynamics and hydrostatics (cross out those that do not apply), as adumbrated by the great scientists . . . or . . . how ridiculous, I shall be forgetting my own name next. Why? Because, as any hydraulician will tell you, there is no simpler or more efficient way of converting the high speed rotary power of a motor into the slow speed linear power needed to operate these airframe accessories—these gadgets. Hence the hydraulic pump and ram; and hence the bewildering range of plumbing which lies before me, in diagrammatic shape, as I write, and which some revoltingly smug hydraulician has had the nerve to label: "Simple chart showing flow of oil in hydraulic system of Large Modern 'Plane."

I will say no more about this masterpiece of modern design except that it contains more arrows than a penal settlement, and that any fluid capable of finding its way round the maze must be essolutely marvellous. *Esso*lutely!

Like the fuels and lubricants with which it is associated, the hydraulic fluid must do its job under all possible conditions—at great heights, at temperatures as low as minus sixty degrees C. (and lower!) and as high as one hundred degrees C. It must remain completely unruffled and behave with the utmost sang-froid even when sorely tempted to stage a sit-down strike or go all temperamental. In other words it must never betray its feelings by any marked change in viscosity: otherwise, of course, the gadgets or airframe accessories (including the retractable undercarriage) will not function with their accustomed and very necessary smoothness.

For reasons of economy, and in order that the size of pumps, pipes and jacks can be kept reasonably miniature, hydraulic systems are worked at very high pressure—which means another strain on the poor old fluid. But the oil technicians manage somehow to bolster up its resistance and aplomb in their own inimitable fashion.



There is one possible snag. Inflammability. High-pressure systems *can* leak, and when they leak the fluid is finely atomised and susceptible to ignition.

What are the researchers doing about this? Well, they're working *esso*lutely to develop new fluids—fluids endowed with *all* the virtues, including non-inflammability, and at the time of going to press success is very much in sight.

So it pays to fill up with the *right* hydraulic fluid, and

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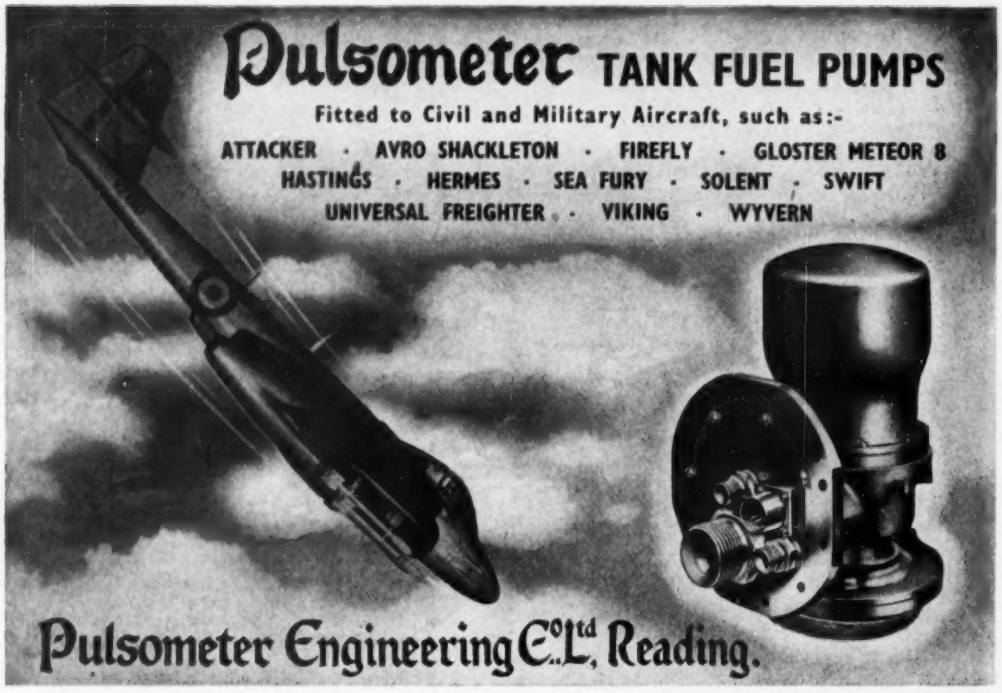

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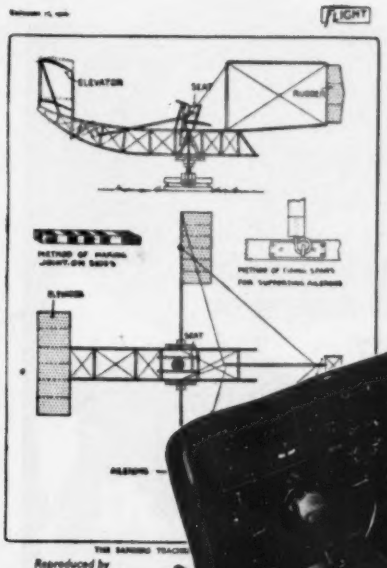

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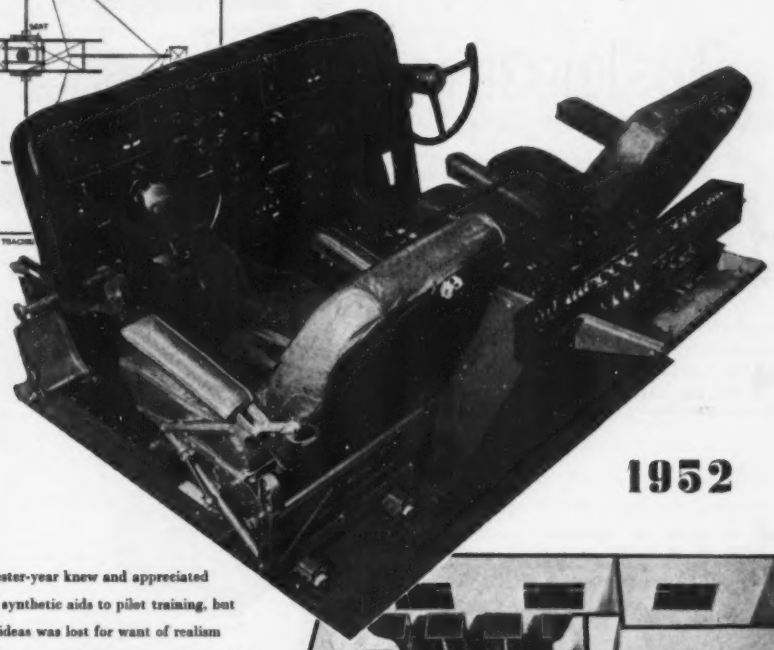
1910

Pioneers in Flight Simulation



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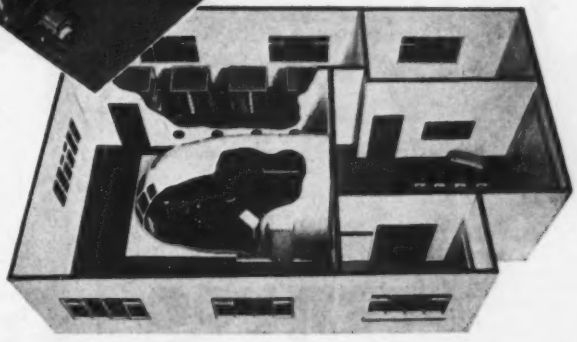

The pioneers of yester-year knew and appreciated the advantages of synthetic aids to pilot training, but the value of their ideas was lost for want of realism until progress in the science of electronics made possible the high degree of simulation to be seen in the modern Redifon Flight Simulator.

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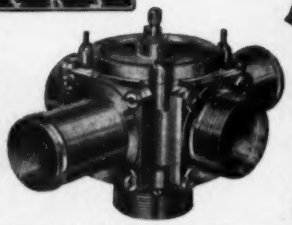

3, 4 and 5-way versions of the Saunders S.P. Cock were announced at Farnborough and models are already in production for prototypes of British aircraft. Features of these multi-way cocks are similar to those in the standard 2-way models: full bore, low torque even at temperature extremes and glandless, leak-proof construction.

A lot of Fluid—and lots of Fluids

Aircraft constructors and operators are constantly confronted with fluid handling problems both of volume and variety. Although the wide range of size and type of Saunders Cocks provides solutions to many difficulties the makers realise that each new project may pose some fresh puzzle and accordingly place at the disposal of engineers the experience of a staff of specialists in this subject.

Saunders 4" S.P. Cock

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In the Comets, in addition to the fuel and oil supplies, hot air (at 250° C) is controlled by an all-metal version of the S.P. Cock and water injection is handled by large bore cocks.

A lot of fluid finds its way aboard the Hastings and, again, the control is entrusted to Saunders S.P. Cocks of which 18 are installed in each aircraft.

Saunders S.P. Cocks also handle lots of aircraft fluids other than fuel and oil, such as oxygen, nitrogen, L.P. hydraulics, de-icing fluid, etc., and vacuum.

When a lot of fluid has to be handled at once, as in pressure refuelling, large pipelines are obviously demanded and to meet these, and similar demands, the Saunders 4-in. S.P. was introduced.

Cut the Cackle

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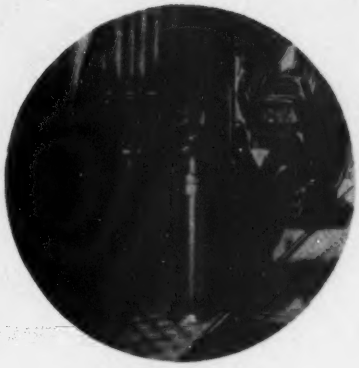

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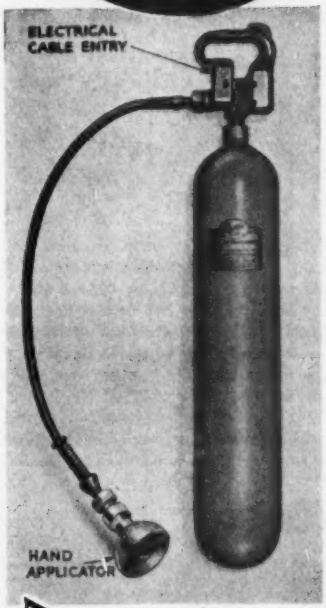

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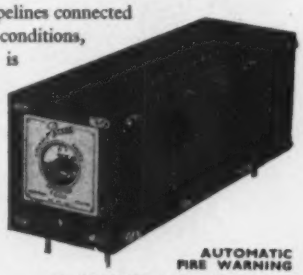

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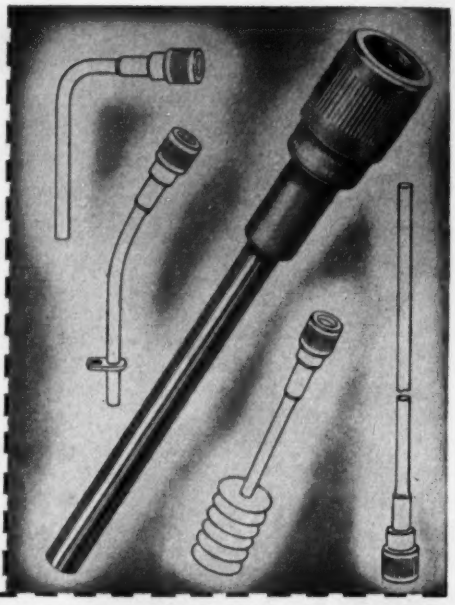

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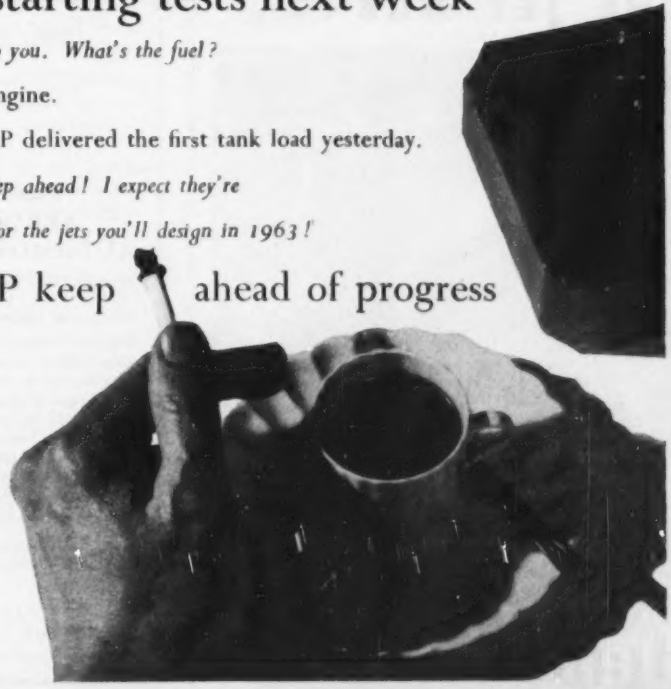

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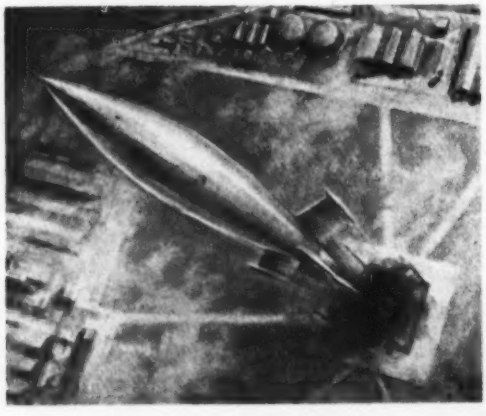

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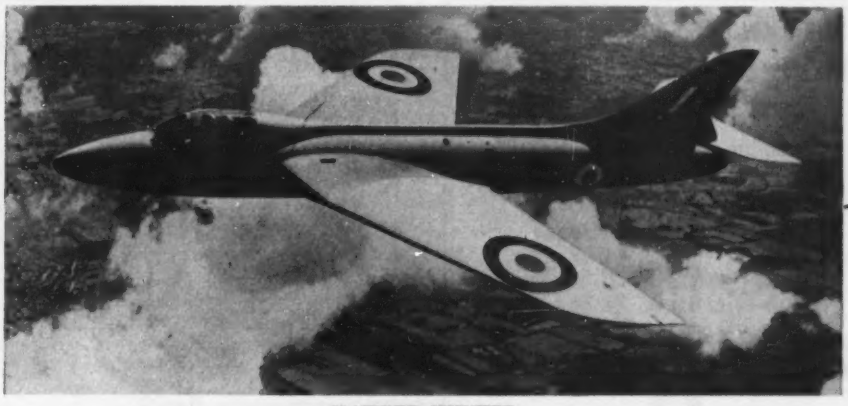

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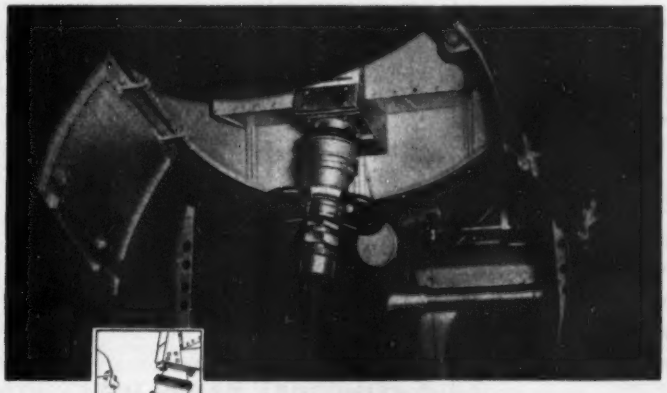

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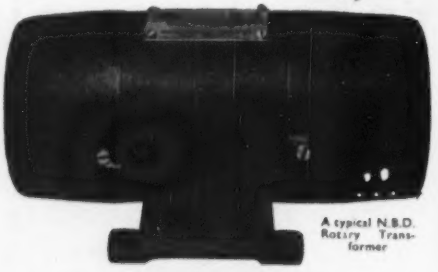

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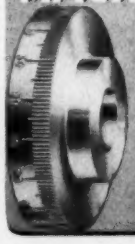

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CARAVAN. "Pilot Panther," 4-berth, first-rate condition, £900.—Williams, Church Moor Hall, Church Stretton, Marshbrook 40. [7834

NEW. "Statesman," £1,005. Other Berkeleys from £389/10/-. New Glider 4-berth de luxe, £360/10/-, and 2-berth, £212. Safari, £268. Towing. Hire Purchase.—Mantles Garages, Ltd., Biggleswade. Tel. 2113. [0397

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R.A.F. and R.N. officers' uniforms purchased; large selection of R.A.F. officers' kit for sale, new and reconditioned.—Fisher's Service Outfitters, 65-68, Wellington St., Woolwich. Tel.: Woolwich 1056. [0567

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LEARN to fly at Redhill Aerodrome, Surrey. South London's nearest flying centre. 25 miles from Hyde Park corner. £3/10/- per hour dual; from £2/10/- solo; instrument flying, instructors' and advanced courses. Attractive clubhouse with full catering facilities.—Tel.: Nutfield Ridge 2345. [0347

HERTS and ESSEX AERO CLUB, Broxbourne Aerodrome, Nazeing, Essex. M.C.A. approved 30-hour course; solo flying from 30/- per hour; residential; trial lessons 35/-; train from Liverpool Street or Green Line Coach 718.—Tel.: Hoddesdon 2243, 2441, 3705. [0330

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WING COMMANDER R. H. STOCKEN, F.R.Ae.S., Eagle House, 109, Jermyn St., London, S.W.1. Tel.: Whitehall 0883. [0419

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A SUMMARY

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All equipment is, prior to dispatch, inspected and tested in our A.R.B. approved Overhaul Laboratory, and these facilities are thus available to the industry as a whole for C. of A. overhauls, repairs, etc.

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AIRCRAFT hangar for sale. 60ft. clear span by 144ft. long by 20ft. clear height. Doors one end. All steel. Covering steel or asbestos sheets.—Bellman Hangars, Ltd., Terminal House, London, S.W.1. (No agents, please.) [7794

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ALL types of aircraft insurance and personal accident cover.—Apply to J. W. T. Amey, Messrs. R. J. Moffat and Co., Percy House, 796, High Rd., Tottenham, N.17. Tel.: Tottenham 2000-4-8. [0684

MISCELLANEOUS

BALLOON winches powered by Ford V8 engines, believed very suitable for towing gliders. Several available for disposal. Offers invited.—Foundation Oil Co., Ltd., 9, Orford Hill, Norwich. Phone 20307. [7920

FOR disposal, one four-wheel flying control office with perspex roof; one airfield fire crash tender; three Thompson aircraft refuellers; one ambulance; three Clark Truc-Tractors, for towing aircraft; airfield floodlight equipment; 450 and 900-gall. four-wheel tanker trailers, and 900-gall. Bedford four-wheel drive tankers.—Foundation Oil Co., Ltd., 9, Orford Hill, Norwich. Phone 20307. [7873

PATENTS

THE proprietor of British Patent No. 616814, entitled "Hinge Structure," offers same for license or otherwise to ensure practical working in Great Britain.—Inquiries to Singer, Stern and Carlberg, 14, East Jackson Boulevard, Chicago 4, Illinois, U.S.A. [7870

THE proprietor of British Patent No. 614425, entitled "Latch Assembly," offers same for license or otherwise to ensure practical working in Great Britain.—Inquiries to Singer, Stern and Carlberg, 14, East Jackson Boulevard, Chicago 4, Illinois, U.S.A. [7871

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TUITION

THE COLLEGE OF AERONAUTICS.

THE Board of Entry of the College invites applications from suitable candidates for the two-year course commencing in the autumn of this year. Candidates should be of graduate standard, although the possession of a degree is not essential; a good Higher National Certificate is an acceptable qualification. The College, a post-graduate institution, is devoted to the study of aeronautical science and engineering. The curriculum covers the five main subjects of aerodynamics, aircraft design, aircraft electrical engineering, aircraft propulsion, and aircraft economics and production. Instruction in the first year is designed to provide students with a broad background of knowledge in all subjects, with opportunity for limited specialization in two or three subjects. In the second year students specialise more particularly, usually in one subject. Experiments in the air are an important part of the work, both in the first year when all students take part in them and in the second year when they are linked to the specialist work of the departments. Students who satisfactorily complete the course will receive the diploma of the College.—Further particulars and details of the procedure for enrolment may be obtained on application to: The Registrar, The College of Aeronautics, Cranfield, Bletchley, Bucks. [7792

LONDON SCHOOL OF AIR NAVIGATION (1949), Ltd.

PERSONAL coaching for Commercial Instrument Rating, Senior Commercial, A.L.T.P. (conversion thereto) and Flight Navigator licences. This school provides the most rapid and economical method of qualifying. I.C.A.O. standards.

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LEARN to fly for £24; instructors' licences and instrument flying for £3 an hour; night flying £3/10/- an hour, residence 4½ gns. weekly. Approved M.C.A. private pilot's licence course.—Wiltshire School of Flying, Ltd., Thruxton Aerodrome, Andover, Hants. [0253

A.F.R.Ae.S., A.R.B.Certs., A.M.I.Mech.E., etc., on "no pass, no fee" terms; over 95% successes. For details of exams and courses in all branches of aeronautical work, navigation, mechanical eng., etc., write for 144-page handbook free.—B.I.E.T. (Dept. 702), 17, Stratford Place, London, W.1. [0707

FREE! Brochure giving details of courses in all branches of aero eng. covering A.F.R.Ae.S., M.C.A. exams., etc. We are the only postal training college operated by an industrial organisation.—Write to E.M.I. Institutes, Postal Division, Dept. F26, 43, Grove Park Road, London, W.4. Tel.: Chiswick 6417. Associated with H.M.V. [7906

SOUTHEND-ON-SEA MUNICIPAL FLYING SCHOOL, Essex. Tel.: Rochford 56204. Comprehensive training for private, commercial licences and instructors' endorsements. M.C.A. approved for 30-hour course. Auster aircraft fitted with radio. Hourly rates: Solo, day £3, night £4; dual £- extra; contract rate £2/10/-; Link trainer 10/-. No fees or subscriptions. Please write for further details. [0032

COLLEGE OF AERONAUTICAL AND AUTOMOBILE ENGINEERING, Chelsea and Redhill Aerodrome. Diploma course in aeronautical engineering combine full day workshop and technical training with coaching for R.Ae.S. Associate Fellowship examination. Parts 1 and 2 aircraft engineers, licences, etc., in preparation for executive positions.—Syllabus from the College Secretary, Sydney St., Chelsea, S.W.3. Tel.: Flaxman 0221. [0010

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

AIRCRAFT estimators, rate fixers and inspectors required, for airframe factory in the south-west area. —Write, giving full particulars, to Box N.4004, A.K. Advr., 212A, Shaftesbury Ave., W.C.2. [7886

SITUATIONS VACANT

1. West African Airways Corporation invite applications for vacancies which will shortly occur due to their expansion.

2. Two radio engineers holding radio engineer's licences in categories "A" and "B," but applicants with single category "A" will be accepted. Applicants without licence cover will be considered provided they are willing to take the licence examination after they have gained practical experience in West Africa. Preference will be given to men with experience on AD.97/208, AD.107 and AD.709Z.

3. Two electricians holding an "X" (electrical) licence are required for flight and/or overhaul work. Training in the United Kingdom will be given to the selected applicants to enable them to obtain a Hermes IV electrical endorsement. Uniformated electricians will be considered for these vacancies provided they have sufficient experience in the type of work they are expected to undertake.

4. The commencing salaries will be determined by experience and qualifications and the minimums offered are:

Unlicenced engineers basic salary	£370
Single licence engineers basic salary	£810
Double licence engineers basic salary	£900

In addition to the above basic salaries, expatriation pay at the rate of £180 p.a. is payable to unlicenced engineers and £200 p.a. for those with licence, plus a cost-of-living allowance amounting to 10 per cent of the basic salary. These sums are payable with effect from the date the selected applicants arrive in West Africa.

5. Free fully furnished modern quarters are provided for all staff, but due to accommodation difficulties, initial separation from families for a few months is necessary.

6. Leave in the U.K. with free passages for the employee and his family is granted at the rate of 1.5th of the period of time served in West Africa, leave will normally be granted after a tour of 15 months.

7. The following schemes are at present in operation: Sickness and accident scheme, car purchase scheme and a pension scheme. Brief details of the pension scheme are as follows:

(a) Employees contributions 6 per cent of salary. Employers, 16 per cent.
(b) Retiring age 55, but staff may elect to retire at 50, after 10 years' service.
(c) After five years' service, employees who resign may claim a refund of the employer's contributions in addition to their own.

8. Applications should be addressed to the Staff Manager (Stations and Traffic), B.O.A.C. (A.B.U.), Airways House, Great West Road, Brentford. The closing date for receipt of applications will be May 1st, 1952. [7909

West African Airways Corporation

An Appointments Board will sit in London shortly for the purpose of selecting suitable candidates for aircrew vacancies which will occur in the near future, due to recent expansion.

Minimum qualifications will be a current airline transport pilot's licence and general flight radio telephony operator's licence. Applicants with a senior commercial pilot's licence may be considered for vacancies as first officers.

(1) First officers. Aged 30 years and under. Salary according to qualifications and experience within the range of £1,335 to £1,515 per annum, plus cost-of-living allowance whilst in West Africa of approximately £100 per annum.
(2) Junior captains. Salary according to qualifications and experience within the range of £1,535 to £1,805 per annum, plus cost-of-living allowance whilst in West Africa of approximately £120.
(3) Captains. Salary according to qualifications and experience within the range of £1,805 to £2,300 per annum, plus cost-of-living allowance whilst in West Africa of approximately £150 per annum.

Free fully furnished accommodation is provided in West Africa but married men on initial engagement may be required to serve for a few months before being joined by their families.

Free return passages are provided each tour for the employee, his wife and up to two children, not exceeding 18 years of age.

Tours of duty will be from 13 to 15 months with leave on full salary at the rate of one-fifth of the period of service in West Africa.

Conditions of service will include membership of a pension scheme, allowing retirement at 45, subject to a minimum of 10 years' service (retirement 5 years earlier may be arranged by mutual agreement). In the case of employees not completing 10 years' service, a gratuity arrangement exists whereby, subject to a minimum of four years' service, a payment at the rate of £150 for each full year of service will be made on termination of appointment.

A contributory medical scheme exists for employees and families subject to a contribution of 20s. per head per month.

Intending applicants should apply in the first instance to: Staff Manager (Stations and Traffic), (A.B.U.) B.O.A.C. Airways House, Great West Road, Brentford, Middlesex. [7919

Her Majesty's Colonial Service

Graduates in physics or mathematics with first or second class honours are invited to apply for posts as meteorological officers in North Rhodesia. Two years' experience in aviation forecasting is desirable but successful candidates with no previous experience will be given a course of training. The posts are permanent and pensionable after two years' probation with salary in the scale £650-£1,140 according to experience plus a temporary non-pensionable cost-of-living allowance of 16 per cent of salary. Age limits, 23 to 45 years. Tour of service, three years. Low income tax. Candidates should apply to the Director of Recruitment (Colonial Service), Sanctuary Buildings, Great Smith Street, S.W.1, giving brief details of age, qualifications and experience, quoting reference number 27110/14/52. [7905

Vickers-Armstrongs, Ltd. (Aircraft Section) have vacancies at Hurn Depot for the following staff:

AIRCRAFT STRESSMEN
DESIGN DRAUGHTSMEN
(aircraft experience preferable but not essential)
JIG AND TOOL DRAUGHTSMEN
(aircraft experience preferable but not essential)
FLIGHT TEST OBSERVERS
(experienced—at least H.N.C. standard—must be physically fit and approximately 30 years of age or under)

Apply in writing, to Employment Manager, Vickers-Armstrongs, Ltd. (Aircraft Section), Weybridge, Surrey. Applications are subject to the approval of the Ministry of Labour and National Service. [7910

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One "B" Engineer with endorsement for Dove. Salary £E1,100 by 4 years to £E1,250.*

One "D" Engineer with endorsement for Queen 70. Salary £E1,100 by 4 years to £E1,250.*

* Plus cost-of-living allowance of approximately £E74 per annum.

("B" and "D" Engineers holding "A" or "C" endorsements for Dove and Queen 70 will rate for additional salary.)

90 days paid leave per annum; free air passage for families. 3 year contract with option to renew.

Engagements will be arranged through Employment Exchange or Scheduled Employment Agency.

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Sutton Lane, Langley, Bucks.
Telephone: Langley 520

SITUATIONS VACANT

Her Majesty's Colonial Service

FEDERATION OF MALAYA (27320/15)

Vacancies exist for air traffic control officers, Grade I, in the Federation of Malaya. Candidates should possess School Certificate, have passed a recognised air traffic control course and possess a certificate of competency enabling them to take sole watches in air traffic control centres, aerodrome and water aerodrome control and approach control. They must be between 21 and 35, and preference will be given to those who have aircrew experience, knowledge of civil aviation legislation or radio and radar navigation aids, or a pilot's or navigator's licence. Duties include exercising control for all types of aircraft at land and water aerodromes up to international standards. Appointment on contract for one tour of 3-4 years in first instance. Salary according to qualifications and experience in scale £350 by £30 to £1,100 per annum plus expatriation allowance of £120 to £231 per annum. Cost-of-living allowance of between £336 and £787 according to family commitments also payable. On satisfactory completion of contract gratuity is payable at rate of £2b for each completed three months' service (including approved leave), or at £37 10s. for each three months' service on salary of £1,000 per annum or over. Nominal rent charged for Government quarters when available. Free return passages once in each tour for officer, wife and up to three children under ten. Local taxes, including income tax, are much lower than in United Kingdom.

Intending candidates should apply, in writing, to the Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, S.W.1, giving brief details of their age, qualifications and experience. They should mention this paper and quote the reference number (27320/16). [7906

The De Havilland Aircraft Co., Ltd.

have vacancies for

Senior Design and Intermediate Draughtsmen

preferably with aircraft experience in their Hatfield and London (Regent Street) offices.

Applications, stating age, experience and salary required to

Chief Draughtsman,
The De Havilland Aircraft Co., Ltd.,
Hatfield, Herts. [6991

Handley Page, Ltd., have vacancies for:—

(a) Junior assistants, male or female, for work in their Test House at Cricklewood, on material and process control.

(b) Junior and senior assistants of H.N.C. or degree standard for work in their Mechanical and Structural Test Dept. at Radlett.—Write, stating age and full particulars of qualifications and experience, to: Staff Officer, Handley Page, Ltd., Claremont Rd., London, N.W.2. [7798

Blackburn and General Aircraft, Ltd. require Senior Jig & Tool Design Draughtsmen for interesting work on Aircraft and Aircraft Engine programmes.

Apply Labour Office (open Saturday mornings), or Please write, stating age, experience and qualifications to The Personnel Superintendent, Brough, East Yorks. [7801

Handley Page, Ltd., have vacancies for:—

Aerodynamicists of degree standard or with H.N.C. in aero subjects. Previous experience preferred.

Wind tunnel technicians of degree standard or with H.N.C. in aero subjects. Previous experience preferred.

Stressmen of degree standard or with H.N.C. in aero subjects. Previous experience preferred.

Weights control engineers with minimum qualifications of O.N.C. Previous experience preferred.

Senior design and intermediate draughtsmen, preferably with aircraft experience, for Cricklewood and Radlett offices. Consideration will be given to applicants with experience in light structural or mechanical engineering. Possession of O.N.C. or H.N.C. (Mech. or Elect.) an advantage.

Loftsmen with previous experience of full-scale layout work or similar workshop practice.

Technical authors, preferably with experience in the preparation of maintenance manuals, pilots' notes, technical specifications, etc.

Technical illustrators with previous experience in aircraft work.—Write, stating age, qualifications and details of experience, to: Staff Officer, Handley Page, Ltd., Cricklewood, London, N.W.2. [7760

D. Napier and Son, Ltd., The Airport, Luton, require:—

One senior technical assistant, for employment in the Flight Test Office, on development of aero engines and installations, preferably with aeronautical fellowship or equivalent qualifications.

Some knowledge of performance and theory of gas turbines desirable, and ability and willingness to fly, an advantage.

Also:

Several male or female computers of at least matriculation standard, and preferably with some computing experience.

Applicants should apply to their nearest Employment Exchange. [7914

Charter company operating from Croydon require pilot immediately. S.A.L.P.A. rates paid. Applicant should give age, experience, licences, etc.—Box 7928. [7984

Chief engineers required, A and C licences endorsed for Rapide. Commencing £450-£500 p.a. — Apply: E.A.F.S., Southend-on-Sea Airport. [7926

Buyer. Assistant to chief buyer urgently required. Previous experience in aviation industry essential. Advise full particulars of previous experience, etc., by letter to: Chief buyer, Aviation Traders, Ltd., 15, Great Cumberland Place, London, W.1. [7945

SITUATIONS VACANT

S. SMITH & SONS (England), Ltd., Bishops Cleeve, Cheltenham, require the following staff:—

SENIOR engineer to lead a section in the design and development of small servo systems, including the application of gyroscopic and magnetic amplifier techniques. This is a permanent post and carries superannuation benefits, and housing assistance will be given to successful applicant. Commencing salary £900 to £1,200, dependent on age, qualifications and experience. Ref. 4/EN/G.

SENIOR mechanical engineer to control design and development of a wide range of aircraft instruments and allied equipment. Applicants should have a sound technical education with previous design experience in pressure-sensitive elements and intricate mechanisms. Salary £900 to £1,200, depending upon age and experience. Ref. 5/EN/M.

DEVELOPMENT engineers for development of high grade test equipment in connection with manufacture of automatic pilots and aircraft instruments. Work involves application of electronic techniques over a frequency range from zero to approximately 100 K.c. c.p.s., together with light electrical and mechanical engineering. Preference will be given to applicants with experience of applied measurements in one or more of the above engineering fields, but the foremost qualification is a sound appreciation of fundamental engineering principles. Salary according to qualifications and experience. Ref. 1/EN.

DEVELOPMENT engineers. Senior and junior engineers experienced in the design of electronic test equipment, including valve voltmeters, C.R.O., oscillators etc. Applicants will be responsible for the development of research models to the production stage and must have a good fundamental knowledge of electrical theory and practical experience of design. Salary dependent on qualifications and experience. Ref. 2/EN.

DEVELOPMENT engineers for work on auto control and servo systems. Applicants with experience in low frequency electronic techniques (including the use of magnetic amplifiers. Preference given to those with previous experience in designing equipment for aviation requirements. Salary according to qualifications and experience. Ref. 3/EN.

WRITE, quoting reference numbers, and giving qualifications and experience, to the Personnel Manager. [7853]

COMMERCIAL pilot with light aircraft experience required immediately.—Box 6006. [7913]

SENIOR stressman required by South Coast firm for work of great interest. Excellent conditions.—Apply, Box 7495. [7790]

JIG and tool draughtsmen required by Percival Aircraft, Ltd., Luton Airport, Beds, fully experienced.—Applications, in writing, to Manager, Ministry of Labour and National Service, Luton, Beds. [7993]

LICENSED radio engineer and radio mechanics at our base at Stansted Airport, Essex.—Apply by letter or telephone to the Senior Radio Engineer, Aviation Traders Ltd., Southend Airport, Essex. Tel.: Rochford 5641. [7950]

WYNSTRUMENTS, Ltd., of Staverton Aerodrome, Gloucester, invite applications for instrument mechanics, particularly those with electrical instrument experience; alternatively, all-round aircraft instrument experience. [7986]

CHIEF designer draughtsman required S.E. London area, with experience of design and development of aircraft instrument mechanisms.—Applicants should write stating age and salary expected, with details of experience to Box F.994 at 191, Gresham House, E.C.2. [7912]

JUNIOR draughtsman required, S.E. London area, with experience of design and development of aircraft instrument mechanisms.—Applicant should write, stating age, salary expected, with details of experience, to Box F.993 at 191, Gresham House, E.C.2. [7911]

DRAUGHTSMEN (Intermediate) required. Technically qualified with mechanical design and production experience preferably in aircraft industry. Please apply Personnel Manager, Flight Refuelling, Ltd., Tarrant Rushton Airfield, Nr. Blandford, Dorset. [7917]

H. M. HOBSON, Ltd., Fordhouses, Wolverhampton, require draughtsmen for design of test equipment in connection with aircraft fuel systems and hydraulic accessories.—Apply through Local Employment Exchange. [7921]

DE Havilland Aircraft Co., Ltd., Chester, require the services of a flight radio operator holding the M.C.A. first-class licence for installation, ground testing and flying duties. Apply, giving details of age, experience and salary required, to the Personnel Manager. [7927]

WEIGHT estimator required by Percival Aircraft, Ltd., Luton Airport, Beds, for work on fixed wing and helicopter aircraft.—Apply, giving details of age, qualifications, experience and salary required to: Manager, Ministry of Labour and National Service, Luton, Beds. [7992]

GLOUCESTER AIRCRAFT Co., Ltd., have vacancies for fully experienced aircraft structural and electrical draughtsmen.—Applications, in writing, stating age, experience and salary required, must be made through an Employment Exchange or Scheduled Agency. [7910]

TECHNICAL authors and illustrators required by Percival Aircraft, Ltd., Luton Airport, Beds. Knowledge of M.o.S. procedure desirable.—Applications, in writing, stating age, experience and salary required, to Manager, Ministry of Labour and National Service, Luton, Beds.

[7994]

GLOSTER AIRCRAFT Co., Ltd., require senior and junior weight engineers. Interesting work on new projects. Permanent positions offered to suitable applicants. Applications in writing stating experience, qualifications and salary required, must be made through an Employment Exchange or Scheduled Agency. [7912]

INTERNATIONAL AERADIO, Ltd., require a licensed radio engineer for service overseas. Starting salary from £562 p.a. plus adequate station allowance. Quarters, or housing allowance given. Passages paid. Pension scheme. Kit allowance. Paid U.K. leave.—Please apply quoting RE. Personnel Officer, 40, Park Street, W.1. [7916]

H. M. HOBSON, Ltd., invite applications for positions in the drawing office as follows: designers, detail and modification draughtsmen, checkers, stressmen. The work is concerned with interesting projects connected with fuel metering equipment and hydraulic flying controls for aircraft.—Hobson Works, Fordhouses, Wolverhampton. [7929]

JIG and tool draughtsman required by manufacturers of automobile and aircraft accessories in South Midlands. Practical experience in toolroom and production shops and good technical qualifications essential. Salary according to ability. Single accomodation available State salary, age and full particulars.—Box 8024 [7900]

WORKS SUPERINTENDENT with experience of repair, overhaul and conversion of British and American aircraft required for aircraft factory in Midlands. Must be good disciplinarian and have experience of modern factory procedure and organisation. Salary commensurate with experience and ability.—Box 8056. [7928]

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SITUATIONS VACANT

AIR SERVICE TRAINING, Ltd., require Category A flying instructors for fighter and twin conversion duties at Karachi. Experience on Harvard, Prefect, Prospect and Dakota desirable. Salary approximately £2,000 per annum.—Application should be made to the Commandant, Air Service Training, Ltd., Hamble, Southampton, marking letters and envelopes F.1. [7927]

IMPORTANT Midlands aircraft engine manufacturer has vacancies for a number of designers and senior and junior draughtsmen. The work is connected with gas turbine engines. Although experience is most advantageous it is not necessarily essential, as training will be given.—Apply in some detail, please, to Armstrong Siddeley Motors, Ltd., Reference 101, Coventry. [7951]

THE GLOSTER AIRCRAFT Co. requires senior and intermediate stressmen to work on designs and projects of advancement for sound and energetic men.—Applications in writing, giving full particulars of technical qualifications, age, experience and salary required, must be made through an Employment Exchange or Scheduled Agency. [7911]

APPLICATIONS are invited from senior and intermediate design draughtsmen. Experience of aero-engine design desirable, but not essential. Also checkers.—Please write, stating age and giving details of previous experience in chronological order to the Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. [7933]

DESIGN draughtsman required by Lockheed Hydraulic Brake Co., Ltd., Leamington Spa. Should be fully experienced in light mechanical engineering. Knowledge of hydraulics an advantage. Opportunity for early promotion to section leader on proof of ability. Single hostel accommodation available.—Apply, Employment Exchange. [7934]

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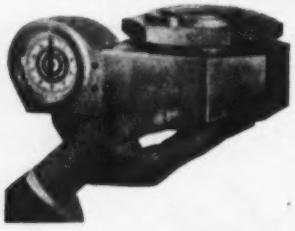

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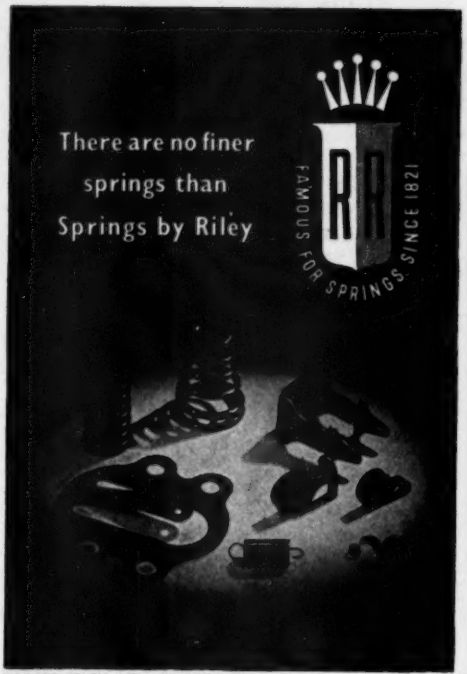

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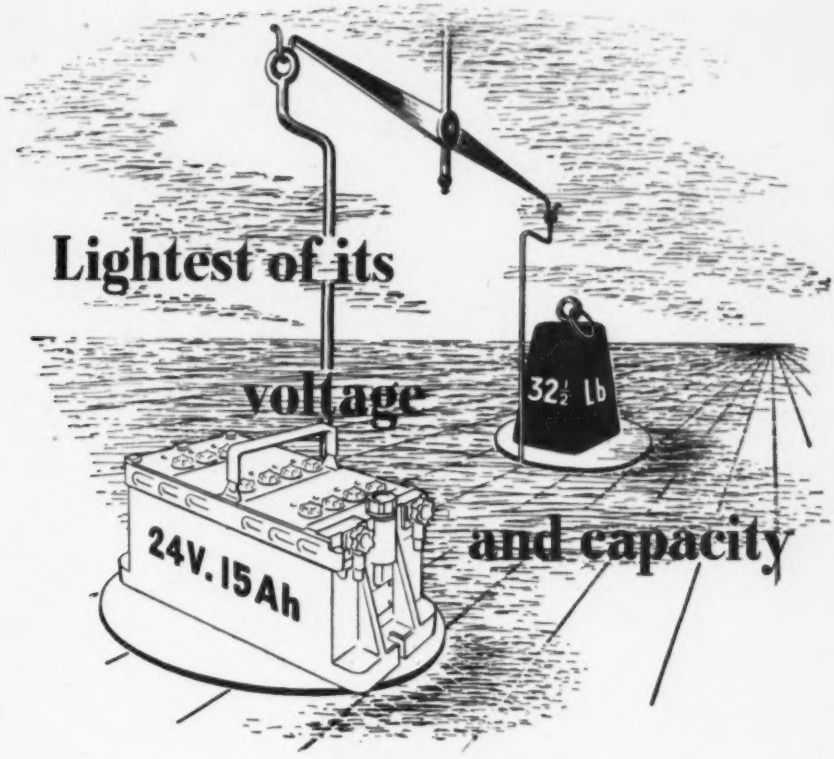

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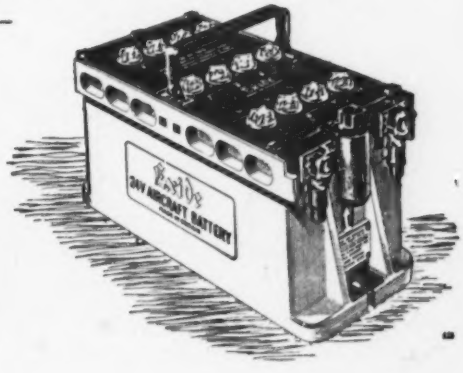

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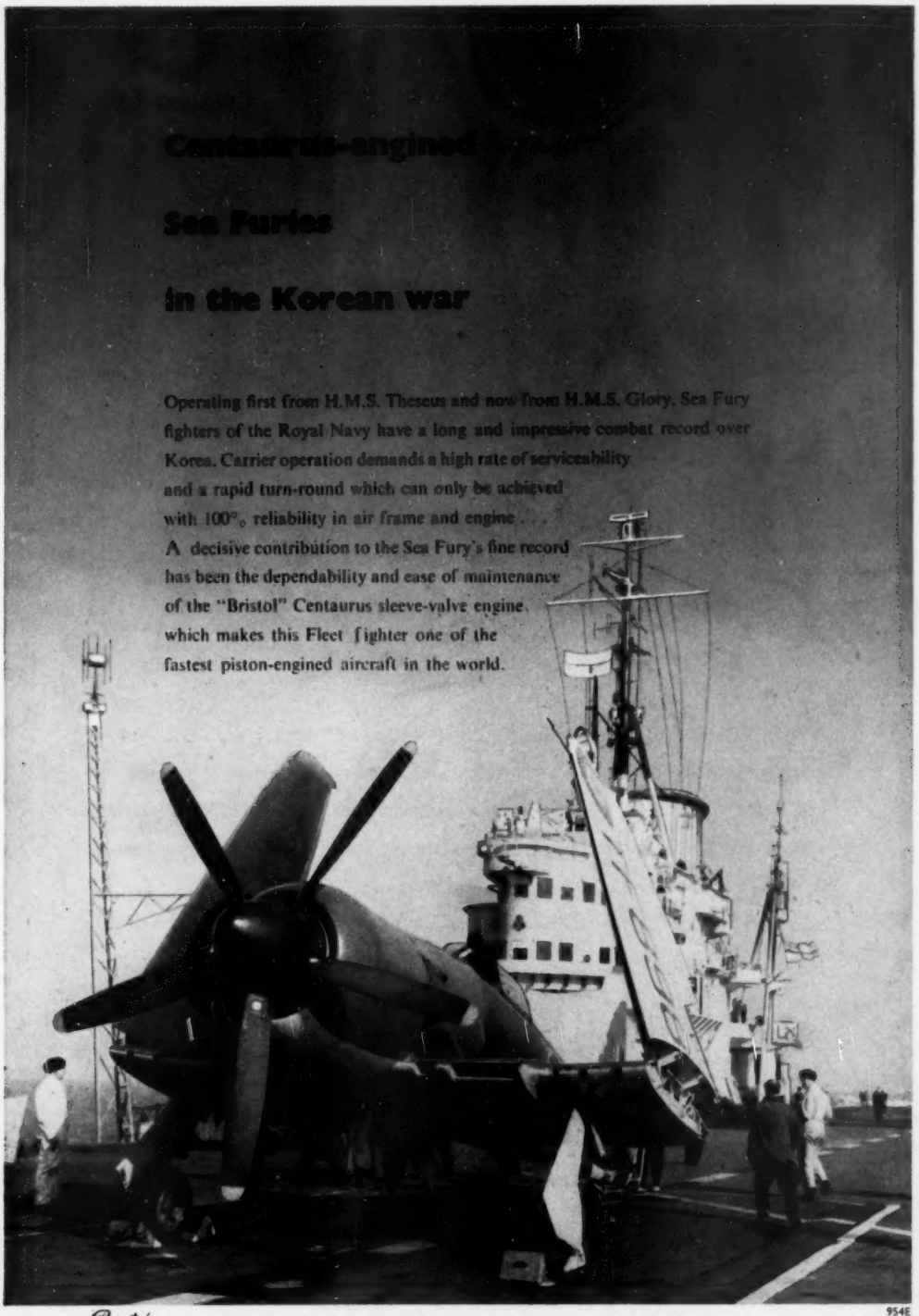
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